VOL. II.

BROMIDE OF ETHYL
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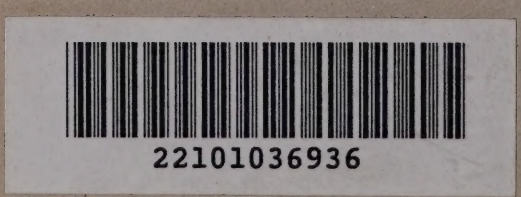
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ANNUAL

AND

ANALYTICAL CYCLOPÆDIA

OF

PRACTICAL MEDICINE

BY

CHARLES E. de M. SAJOUS M.D.

AND

ONE HUNDRED ASSOCIATE EDITORS

ASSISTED BY

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PREFACE TO THE SECOND VOLUME.

THE majority of the sections included in the first volume, as stated in the preface of the latter, were prepared under the immediate supervision of the editor and submitted to the various members of the associate staff for revision and correction. Each associate enjoying the privilege of erasing, changing, and adding anything he chose, the correctness of the views advanced was insured, while the innovations as to form introduced by the editor could satisfactorily be carried into effect. The second volume inaugurates the regular plan of the work as regards elaboration: all the articles have been prepared by their respective editors, and the result shows the kindly interest taken in the work by all the members of the staff, to whom the editor extends expressions of sincere gratitude.

The aim of the editor is not only to facilitate the labor of the practicing physician and to assist investigators and authors in their researches, but he also seeks to elucidate, through contributions from men possessing special knowledge or unusual experience in a particular line, diseases which, owing to their complexity, are not generally understood. This plan has borne fruit, and the readers will have before them, in this volume, exceptionally-valuable articles on a number of exacting subjects, namely: "Cerebral Hæmorrhage," by Dr. William Browning, of Brooklyn; "Cirrhosis of the Liver," by Professor Adami, of Montreal; "Cholera," by Professor Rubino, of Naples; "Cholelithiasis," by Professor Graham, of Toronto; "Diabetes," by Professor Lépine, of Lyons, etc. The better-known affections have also been edited by writers of special ability. Among the articles of this kind is that on "Diphtheria," by Drs. Northrup and Bovaird, of New York, who contribute a masterly review of our present knowledge of this affection from every stand-point. The papers by Professor Eskridge, of Denver, on "Catalepsy"; Professor Bondurant, of Mobile, on "Chorea"; Dr. Norman Kerr, of London, on "Cocainomania"; Dr. Oliver, of Philadelphia, on "Cataract"; Prof. Nathan S. Davis, of Chicago, on "Constipation"; Dr. Vickery, of Boston, on "Dilatation of the Heart," are, among others, particularly entitled to the readers' special attention. An infirmity but little studied by the general practitioner is "Deaf-mutism." A section giving an exhaustive review of the subject has been contributed by Dr. Holger Mygind, of Copenhagen, one of the greatest living authorities upon the pathogenesis of this condition.

The small-type text, presenting selected excerpts from the literature of the last decade and the recent literature up to May 1, 1898, have, as before, been inserted by the central editorial staff. The articles on remedies—including only those in general use—were prepared by Dr. G. Archie Stockwell, whose long experience accounts for the many timely criticisms introduced.

Repeated inquiries having reached the central department as regards the authorship of the fifty-page unsigned article on "Animal Extracts" which appeared in the first volume, the editor wishes to state that he wrote it himself, and that he fully appreciates the kindly expressions relating thereto, and also the many encouraging reviews which the medical press has accorded the first volume.

THE EDITOR.

2043 WALNUT STREET,
PHILADELPHIA, JULY 1, 1898.

SAJOUS'S ANNUAL
AND
ANALYTICAL CYCLOPÆDIA OF PRACTICAL MEDICINE.

B

BROMIDE OF ETHYL.—Bromide of ethyl, or hydrobromic ether, is an anæsthetic prepared by combining bromine with alcohol in the presence of phosphorus. It was discovered by Sérullas, a French chemist, early in this century. It is an extremely volatile and colorless liquid, sweetish to the taste, and possessing an alliaceous odor. It presents the advantage over ether in not being inflammable. It is quickly eliminated from the system, and its after-effects are slight. Another preparation—bromide of ethylene—is frequently dispensed instead of the bromide of ethyl; it causes nausea when inhaled, and in no way possesses the qualities of the latter. Bromide of ethyl is, however, frequently found impure in the shops, and to this cause are due many of the untoward results met with.

The bromide of ethyl usually employed for anæsthetic purposes is made with phosphorus, bromide, and alcohol, and gives off phosphoretted hydrogen,—a dangerous impurity. The drug prepared from sulphuric acid, ethylic ether, and potassium bromide, as in commerce, is purer and, as it contains a larger amount of ethylic ether, is much safer than the other variety. Terrier (Gazette Méd. de Paris, May 12, '94).

Most of the unfavorable symptoms, such as vomiting, are due, not to the bromide of ethyl, but to the impurities too often associated with it. Bazy (N. Y. Med. Jour., June 9, '94).

Bromide of ethyl may be tested as follows: 1. Put it upon the hand. It must evaporate quickly, and absolutely without residue, producing a marked feeling of cold. 2. The filtration with water should be neutral, and should not change on the addition of silver nitrate. 3. The addition of concentrated sulphuric acid should cause no discoloration. If it is colored to brown or yellow, it shows that the ethyl-bromide is undergoing decomposition. Merck (Cincinnati Lancet-Clinic, Nov. 7, '91).

Dose.—Bromide of ethyl cannot be used for prolonged operations, owing to its high volatility. The dose, which varies with the age of the patient, should not exceed 6 drachms. The administration of bromide of ethyl should not be prolonged beyond two minutes.

The dose varies with the age of the patient: 2 to 10 years, 3 to 4 drachms; over 12 years and adults, 4 to 7 drachms, according to general health, the entire dose being given at once. Cumston (Boston Med. and Surg. Jour., Dec. 20, '94).

Ethyl-bromide used in three hundred cases in Billroth's clinic with one death. Its use should be restricted to short operations. Gleich (Deutsche med.-Zeit., Aug., '92).

Bromide of ethyl is of great service

for short operations. Only a pure, perfectly-limpid product, presenting no garlicky odor, should be used. Ladreit de Lacharrière (La France Méd., May 24, '95).

The operation may usually be begun twenty seconds after the first inhalation.

Physiological Action and Untoward Effects.—Bromide of ethyl causes death by arresting the heart's action, and the cases should be watched as if chloroform were being administered,—respiration and pulse simultaneously. The preliminary preparations for its administration are the same, and the recumbent position obligatory under all circumstances. Arrest of the heart may be caused, however, through vasomotor influence originating in an intoxication by compounds formed in the system.

Case of death from acute yellow atrophy of the liver, which occurred in a healthy male. The operation was brief, the anæsthesia marked by some asphyxial symptoms, and followed by severe vomiting for three days. A marked alliaceous smell persisted up to the time of his death. Reiss (Gazette des Hôpitaux, May 15, '94).

Case of death from ethyl-bromide. The patient, aged 31, took 2 fluidrachms from a handkerchief and complained of feeling suffocated. The respiration grew stertorous, and after a slight convulsion entirely ceased and the heart failed. Death occurred in ten seconds, with cyanosis, turgescence of the veins, widely-dilated pupils, and upturned eyes. The horizontal posture was adopted. Analysis of the drug proved its purity. Laborde regards the death as a reflex syncope from irritation of the nasal mucous membrane by the vapor. Anonymous (Bull. de l'Acad. de Méd. de Paris, June 19, '94).

Experiments on animals indicating that the principal anæsthetics do not act simply by causing vasomotor anæmia and hyperæmia, but principally by forming chemical compounds with the protoplasm of the cells of the cerebral cortex and other centres. Högges (Orvosi Hetilap, No. 2, '89).

Case of death from bromide of ethyl after the extraction of a tooth. Asphyxia—due to pulmonary congestion—shown to have been the cause at the autopsy. Heart found fatty. Eschauzier (Annual, '89).

The injurious effects of ethyl-bromide inhalation are due to the fact that it undergoes decomposition, resulting in the formation of compounds having a more toxic effect than the ethyl-bromide itself. Hennicke (Archiv f. exp. Path. und Phar., B. 36, H. 3 and 4).

Case in which bromide of ethyl caused death. The patient suddenly became cyanotic, and the pulse and respiration failed altogether. The post-mortem showed no hyperæmia of the brain, but fatty degeneration was found in the heart, kidneys, and viscera generally. Gleich (Deut. med.-Zeit., Aug., '92).

Tendency to arterial hæmorrhage under its use, and extreme muscular rigidity, amounting, in some cases, almost to tetanic spasm. Brinton (Ther. Gaz., Apr. 15, '92).

Therapeutics.—Bromide of ethyl—as it causes muscular rigidity—should not be used in operations in which relaxation of the muscles would be of assistance. It also increases the chances of hæmorrhage.

Ethyl-bromide used in two hundred cases of minor surgery. Contra-indications are: cases of reduction of dislocation or fracture, as it does not produce muscular relaxation; habitual drinking; cardiac, pulmonary, or renal disease. Roman von Baracz (Zeit. für Therapie, July 15, '92).

In parturition bromide of ethyl is superior to ether or chloroform. A few inhalations are given at the commencement of a pain, and the patient, while losing consciousness of suffering, is nevertheless able to follow the instructions of the obstetrician. Also found very efficient and safe in five hundred minor operations. Montgomery (Therapeutic Gazette, June 15, '93).

[Many observers, after careful trial,

speak well of it for brief operations, but caution against its use in prolonged cases. The inhaler, once removed, should never be reapplied. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

Literature of '96 and '97.

Case, afterward found to be addicted to alcohol, in which the bromide, having been administered for sixty seconds without any signs of anæsthesia supervening, seemed suddenly to take effect, and great rigidity, rapid breathing, and some lividity were produced, which, however, rapidly passed off. In several other cases in which the bromide of ethyl was used the respiration was, as a rule, regular, and the pulse somewhat quickened. The recumbent posture, in all cases, was the one adopted. The patients' ages varied from 7 to 40. The younger ones took it most readily. All the cases felt well enough to depart within ten minutes of the administration, though some hysterical symptoms appeared in two while recovering. H. Kelson (Brit. Med. Jour., Dec 12, '96).

BROMIDROSIS. See HYPERIDROSIS.

BROMINE AND ITS DERIVATIVES (BROMIDES, BROMATES, ETC.).— Bromine is a dark-reddish-brown, volatile fluid, emitting pungent and acrid fumes, caustic in action and taste. It is sparingly soluble in water (1 to 33), very soluble in chloroform, and likewise in ether and alcohol, both of which, however, it gradually decomposes. It combines freely with bases to form salts.

As regards the bromates, the small proportion of bromine contained entitles them to consideration only in connection with their respective bases. The list of bromides is somewhat extended, there being no less than seventeen salts, and these, with half a dozen bromates and a number of other compounds, bring the total of bromine derivatives up to thirty-one. Some, however, are to be regarded as chemicals purely, or chemical curiosities, rather than medicaments, and a few are so rare or expensive as to inhibit general employment.

Bromide of ammonium is a white, granular salt that may, however, with exposure to light and air take on a more or less yellowish hue. Its action is practically the same as that of the potassium, sodium, calcium, lithium, and strontium salts, at least as regards the nervous system. It also, in small doses, is, to some extent, an alterative and hepatic stimulant; but in this particular is no better than, and perhaps not so active as, potassium bromide. It is the least palatable of the bromine salts, has a pungent, saline flavor (bromine taste), and is odorless.

Calcium bromide is capable of evolving 80 per cent. of bromine: a proportion greater than obtains to any other bromide; hence it has been lauded as a *succedaneum* for all the salts of alkaline base. It is had as a white, deliquescent salt, possessed of the usual pungent saline taste.

Lithium bromide presents much the same physical properties as the foregoing; is sharp and bitter to the taste, white, granular, odorless, and the most difficult of all the salts to keep, owing to its deliquescent character.

Potassium bromide appears as colorless, odorless, cubical, translucent, nonhygroscopic crystals of bitter, pungent, saline taste, and contains an average of 67 per cent. of bromine.

Sodium bromide exhibits a considerably larger percentage (77.5) of bromine than its potassic congener, and, though it has characteristic bromine taste, it is most palatable of all the salts, and the best borne by the stomach, though this latter claim has been disputed in favor of strontium bromide. It is a white, odorless salt, fairly permanent under all

ordinary conditions of the atmosphere, and is found in the shops in two forms: as a granular powder and as small, monoclinic crystals.

Strontium bromide is a comparatively recent addition to the materia medica, and occurs in colorless, odorless crystals, only less deliquescent than lithium bromide, and possessed of the usual bitter, saline flavor; it contains 65 per cent. of bromine.

Bromal, tribromaldehyde, or tribromacetyl-oxide, is a limpid, colorless, oily liquid possessed of a peculiar, sharp odor and irritating taste, obtained through the decomposition of alcohol by bromine; it is soluble in water, alcohol, and ether, but is not employed medicinally. Its derivative, bromalhydrate, however, was introduced with a view of affording an analogue of, and substitute for, chloral-hydrate, but has failed to secure the favor of medical men so confidently expected. It is a crystalline solid with the taste of bromal.

Bromalin, or bromethylformamide, contains only about half as much bromine as potassium bromide,—*i.e.*, about 24 or 25 per cent.,—and offers no advantages over the common bromide salts; hence requires little attention. It must not be confounded with *bromelin*: a preparation representing the digestive principle embodied in the pine-apple.

Bromamide is a synthetic body obtained by the union of bromine and formamide, and occurs in colorless, odorless, needle-shaped crystals insoluble in hot, but slightly soluble in cold, water, freely so in hot alcohol, and also in ether.

Bromol, or tribromphenol, like the preceding, is a synthetic product, had by the action of bromine on an aqueous solution of carbolic (phenic) acid; it is precipitated as silky crystals that are insoluble in water, but readily soluble in alcohol, chloroform, ether, glycerin, and fats.

The bromates can hardly properly be considered in connection with bromine and the bromides, since their therapeutic relations are markedly those that obtain to their base, hydrobromic acid excepted. The proportions of bromine are comparatively small as compared with bromides, though it must be admitted that their action as salts is, in considerable measure, different from that of their alkaloidal derivatives.

Preparations and Doses. — Bromine, external use only.

Bromide of ammonium, 10 to 60 grains.

Bromide of arsenic (Clemens's solution), 1 to 5 minims.

Bromide of barium, $^1/_{10}$ to 1 grain.

Bromide of cadmium, $^1/_8$ to $^3/_4$ grain.

Bromide of calcium, 30 to 90 grains.

Bromide of camphor (monobromated camphor; camphor monobromide), 2 to 10 grains. See CAMPHOR.

Bromide of ethyl (inhalation only). See BROMIDE OF ETHYL.

Bromide of gold, $^1/_5$ to $^1/_2$ grain. See GOLD.

Bromide of iron, 3 to 10 grains. See IRON.

Bromide of lithium, 20 to 150 grains.

Bromide of mercury, $^1/_2$ to 1 grain. See MERCURY.

Bromide of nickel, 2 to 10 grains. See NICKEL.

Bromide of potassium, 10 to 120 grains.

Bromide of silver, $^1/_4$ to 1 grain. See SILVER.

Bromide of sodium, 20 to 150 grains.

Bromide of strontium, 30 to 150 grains.

Bromide of zinc, 1 to 3 grains. See ZINC.

Bromal, 1 to 2 grains.

Bromalhydrate, $^1/_2$ to 5 grains.

Bromalin, 10 to 120 grains.

Bromamide, 10 to 15 grains.

Bromoform, anæsthetic and topical application only.

Bromol, $^1/_{16}$ to $^1/_8$ grain.

Bromohydric acid, dilute, 2 to 120 minims. See HYDROBROMIC ACID.

Bromohydrate of caffeine, 1 to 6 grains. See COFFEE.

Bromohydrate of conine, $^1/_{30}$ to $^1/_{10}$ grain. See CONIUM.

Bromohydrate of quinine, 1 to 20 grains. See QUININE.

Bromohydrate of scopolamine, $^1/_{260}$ to $^1/_{100}$ grain. See SCOPOLAMINE.

Bromohydrate of strychnine, $^1/_{60}$ to $^1/_{20}$ grain. See STRYCHNINE.

Untoward Effects and Physiological Action.—Bromine, *per se*, cannot be administered internally because of its poisonous and powerfully corrosive properties. When brought in contact with organic matters it rapidly oxidizes and destroys them; hence its chief use is as a disinfectant (1 to 500); it also, sometimes, for like reason, finds employment as a topical application in hospital gangrene, phagedenic ulcers, sloughing chancroids, and like morbidities.

The common bromine salts are in a general way identical in action, the chief difference being intensity and palatability, which, of course, are determined by the amount of bromine each contains, and the character of its base. Potassium bromide is, perhaps, the salt best known and most generally employed, and a general description of its physiological properties may be considered as typical of the ammonium, calcium, lithium, sodium, and strontium salts.

Originally potassium bromide was introduced as an alterative and resolvent, and substitute for the iodide salt, and in small doses it often answers these purposes. But no sooner was its sedative action on the nervous system made apparent than its earlier uses were lost sight of, and to a degree that has practically buried all other properties in oblivion. It depresses the brain and spinal cord in medium doses, rendering the same markedly anæmic if pushed or exhibited in larger doses. If the doses are still further increased and continued, anæsthesia of mucous membranes of eye, throat, and nose is observed, which, doubtless, extends to the entire digestive and intestinal tract, though the evidences thereof are not markedly apparent in the rectum. Bromides diminish sexual desire, and, when pushed to the extreme of bromism, may destroy the same, or at least place in abeyance for a considerable period; at the same time the contractility of muscular fibre is diminished, and capillary circulation retarded. First of all the sensory columns of the spinal cord are depressed by bromides, next the sensory nerves; next the brain and motor columns of the cord; finally the motor nerves. While small doses do not seem to appreciably disturb the heart's action, larger ones depress, and, pushed to ultimate toxicity, death occurs with arrest in diastole.

Brominism is the first definite measure of toxicity, and, unfortunately, bromide of potassium and most of its congeners are eliminated very slowly; hence cumulative action. The cerebral symptoms are: a sense of mental weakness, heaviness of the intellect, and failure of memory; partial aphasia; great somnolence and depression of spirits (H. C. Wood). With these there may be decided impairment of sensibility of the skin, to a degree that considerable heat applied elicits no complaint (Peeche). There is usually violent frontal head-

ache; but this often occurs ere the stage of brominism is reached; and bronchial catarrh and cough sometimes supervene. Where brominism assumes a chronic character, there is a nauseous, fœtid breath, congestion and œdema of uvula and fauces, disturbances of sensation as regards vision and audition, loss of appetite, and hallucinations either with or without mania. Routine practice in prescribing bromides may lead to mania.

The pernicious system of prescribing bromides recklessly for epilepsy and other nervous disorders may lead to severe mental diseases.

> Such routinism in many instances causes patients to become wild and maniacal. In many of the asylums this condition is well recognized under the title of "bromomania." In former times the same class of persons continued along about the same from year to year and did not require to be sent from home; but with routine treatment, at the dispensaries and out-patient departments, much damage is often done by engorging the unfortunates with bromides. For many of these patients go from one dispensary to another and thus get loaded with an amount of bromide preparations that is far in excess of the intent, knowledge, or conjecture of the respective prescribers. When, therefore, a practitioner finds that any of his epileptics give indications of increased excitability or violence, it will be well to investigate the amount of their drug consumption, for it may be the invasion of bromomania. Even doses of 15 and 20 grains frequently repeated and persisted in may induce unfortunate and deplorable results, including delusions, melancholia, and suicidal tendencies. Editorial (Lancet, London, '89).

A condition of the brain may be produced similar to that occasioned by excessive hæmorrhage; *i.e.*, an increased tendency to convulsive action (Clark, Gowers, Rosenbach). The action is not only on the cerebral circulation, but also in the cells of the gray matter of the cord.

> In epileptics phthisis is common, and may be rather produced by the drug than by the disease for which the bromide is given. Peculiar mental disturbances may be met with from its continued administration. The discharge of nerve-force is mental rather than motor, and there ensues a convulsion of ideas rather than a convulsion of muscles. Baker (Med. Register, Dec. 8, '88).
>
> By the continued use of bromides a well-recognized form of bromomania may be induced; and epileptics who, fifty years ago, passed easily through life have now to be put under restraint. Thompson (Lancet, London, May 11-25, '89).
>
> In a quantitative examination of the organs of a child who had for years taken large quantities of potassium bromide, the drug was found principally deposited in the brain. Doyon (Jour. de Méd. de Paris, Nov., '89).

Paresis is often induced, with inability to walk, sometimes more marked on one side of the body than on the other and simulating hemiplegia; there may be failure of memory, going on to partial paresis, with involuntary movements of bowels and bladder. In a case of Jacksonian epilepsy, in a child, a drachm of potassium bromide was given daily. The father, a druggist, reasoned that, if this amount kept the disease in check, 2 or 3 drachms during the same period ought to work a cure. But the child speedily sank after the larger doses were instilled and became an imbecile. Also two children were taking bromide; one lost all memory of words and the other all idea of time.

> Case of a lady who took 60 grains daily of potassium bromide for four years, and as a result suicidal tendencies and melancholia developed at each menstrual period, which, however, disap-

peared when the drug was withdrawn. S. Weir Mitchell (Proc. Assoc. Amer. Phys., '95).

Voisin, Stark, Kiernan, Moyer, Rockwell, Seguin, Spitzka, Alexander, and others have reported cases of convulsions arising from traumatic epilepsy that, under the influence of bromides, were replaced by *furor*.

Case of powerful, good-humored man, liable to frequent attacks of *grand mal*, in whom even the post-epileptic state was that of stupor. Bromides rendered him unmanageable, violent, homicidal, querulous, irritable, and suspicious. A second case was the exact prototype of the foregoing. A third was that of a semidemented patient, who became talkative, querulous, and suspicious under bromides. Bannister (Jour. Nerv. and Mental Dis., '81).

Case of female, a victim to *grand mal* suppressed by bromides. In consequence she became irritable, depressed, and suspicious. Rockwell (Jour. Nerv. and Mental Dis., '81).

Literature of '96-'97-'98.

Case of *petit mal*. Bromides induced long-continued attacks of *furor*, where formerly were but casual seizures of erotico-religious mania and visual and auditory hallucinations. Alexander (Med. Standard, '98).

The last author quoted cites several more cases, eight in all. L. W. Baker, of Baldwinsville, three more. Laborde also observed priapism and sexual excitement sometimes amounting to satyriasis follow the use of bromides. Winters, of New York, has recorded many instances of visual hallucinations. Kiernan, of Chicago, and Numro, of Edinburgh, also observed marked aphrodisia. "That these untoward effects closely simulate the effect produced in epilepsy there can be no doubt, yet the weight of authority, and indeed the weight of evidence, is in favor of the opinion that these phenomena result most often from the suppression of epileptic explosions" (Bannister and Alexander).

"To give the bromides alone is to postpone the explosions and generally intensify them. The very fact that a sudden suppression of bromide administration is followed by a severe explosion is clear evidence that the drug acts rather like a load keeping down a safety valve." (Spitzka.)

Not the least unpleasant sequelæ—both as regards patients and medical attendants—that supervene as the result of continuous bromide administration, even in what are often considered very moderate doses, are the manifestations of brominism seen upon the skin. These may range all the way from a simple erythema to a rubeoliform or scarlatiniform rash, up to acne, pemphigus, furuncular swellings, and most foul and stubborn ulcerations that, too often, perhaps, are deemed evidences of a syphilitic diathesis. These are, for the most part, distinctly traceable to morbid changes in the sebaceous glands, in turn induced by impeded capillary circulation and obtunded nerve-fibrillæ. Such eruptions, if not recognized, are very annoying to treat, and are practically impossible to relieve until the bromide is suspended and in great measure eliminated from the system. It is claimed that the simultaneous administration of arsenic tends to inhibit such sequelæ; but this is not, by any means, universally true. The late Brown-Séquard was accustomed to combine belladonna with bromides, which frequently proves a most effective measure.

Literature of '96 and '97.

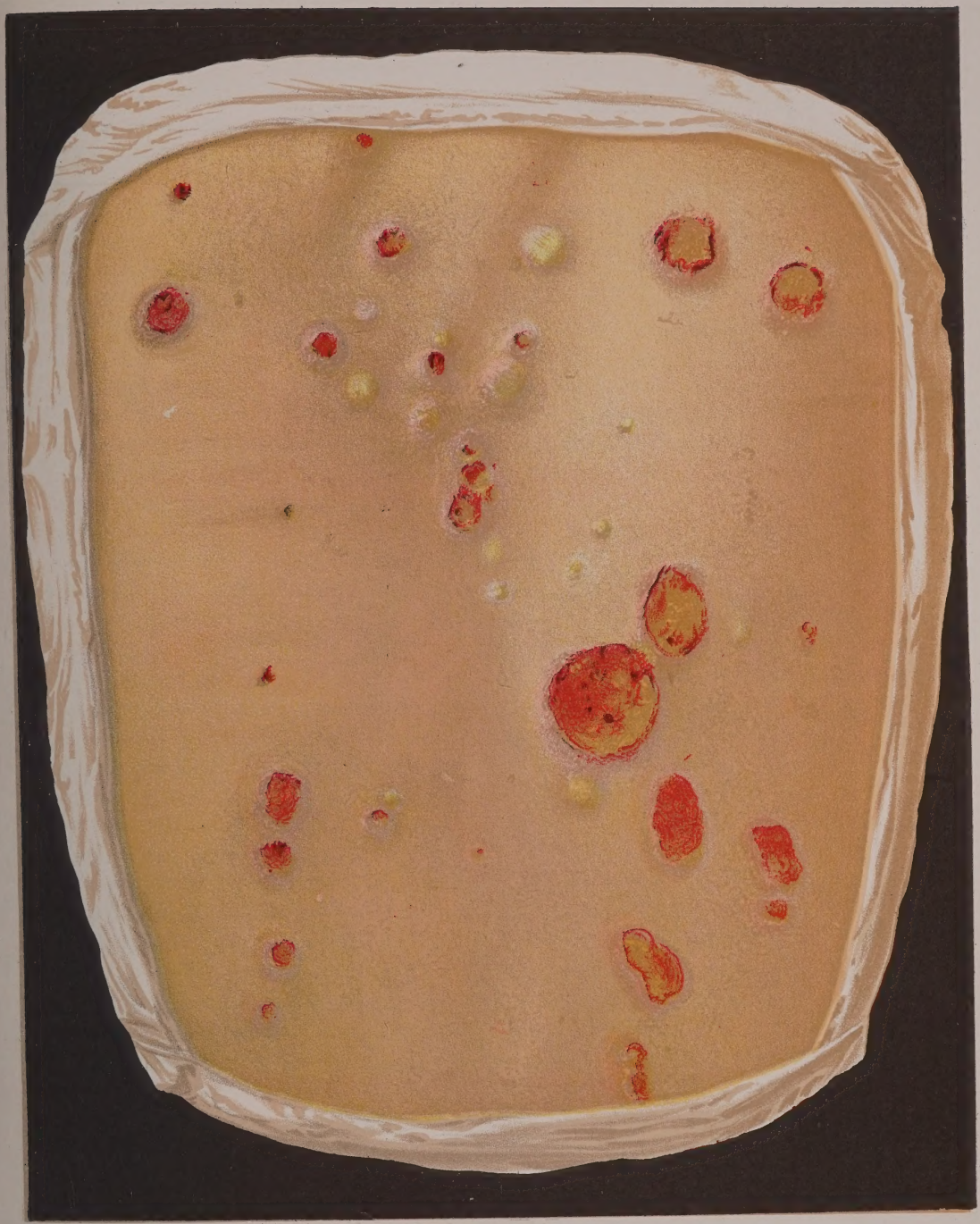
Case of a robust, well-developed child, 3 years of age, suffering from an ulcer on calf of leg, resembling a boil, covered at the apex with raspberry granulations

bathed in adhesive, sanious pus. In a few days the ulcer was surrounded with acne pustules, which coalesced with the original lesion until the latter covered a large part of the gastrocnemius muscle; skin tawney or bronze; breath very offensive. The pustules were immense, and resembled varicella more than acne. Finally the sores threatened the whole leg below the knee. It was found the child occasionally suffered attacks of vertigo, for which a neighboring physician with a reputation for "curing fits" had prescribed large doses of ammonium bromide, under the supposition that he was treating a case of epilepsy. Fullerton (Memphis Med. Monthly, Oct., '97). (*See colored plate.*)

The evidence is overwhelming that the bromides are not the harmless medicaments that they are generally assumed to be; also that their present universal and routine employment should be abandoned for more rational and physiological methods of procedure. When a patient who has been taking bromides for some time complains of a salty or bitter taste soon after the drug has been ingested, especially if there is increased secretion of saliva, suggestions of fœtid breath, or a burning sensation in the mouth, whether accompanied by nausea and eructations or not, such should be regarded as evidence of impending bromism, and measures taken accordingly. It must be remembered, moreover, that these evidences may result from the administration of ordinary medicinal doses—10 to 20 grains in the adult—when frequently repeated, since the emunctories are not able to excrete this amount. Interstitial nephritis is a common sequel to brominism.

Of all the bromine salts, that of ammonium is the most apt to induce toxicity, since the effects upon the sensory portion of the spinal cord are most marked. Bromides of lithium, potassium, and calcium rank, respectively, second, third, and fourth as regards poisonous qualities. Collapse under either the ammonium or potassium salt may arise either through the base or the bromine constituent; but the potassium bromide is more apt to be at fault in this respect. It is sometimes a difficult matter to determine where the blame should rest; but withdrawal of the potassium bromide, substituting therefor another salt,—that of sodium, for instance,—may lead to definite decision. But the most innocuous (apparently) of bromine salts, when long-continued or pushed to extremes, are apt to induce collapse; and fatal pathological changes in both kidney and liver have been ascribed to their use, with considerable reason and probability. Calcium bromide is claimed to be the least depressing, but this is not altogether borne out by long experience in its use.

Lithium bromide requires to be administered in larger doses than its congeners, and often proves the most irritating of any to the digestive system. The strontium salt is least disturbing to the stomach when continuously administered for considerable periods, and by many held the least likely to induce bromism; indeed, H. C. Wood believes it stimulates appetite and increases the activity of the digestive organs, which, however true of small and medium doses, at moderate intervals, is not a fact regarding medium doses with brief intervals long continued or larger doses. The chief advantage of the salt is that its base is practically non-toxic. Barium bromide may be dismissed with the statement that it offers no advantages over the other bromide salts, and it has the marked disadvantage of possessing a very poisonous base. It is also claimed for this salt that it stimulates mucous membrane, improves appetite and diges-



Bromide of Potassium Eruption.

ATLAS DE L' HÔPITAL ST. LOUIS.

BURK & McFETRIDGE CO. LITH. PHILA.

tion, etc., and though this is, in a measure, true, such are referable to the metallic base rather than the acid source.

Sodium bromide is undoubtedly the most convenient, and to considerable degree the most safe of the bromide salts. Suitably diluted, it is no more disagreeable to the palate than the bulk of mineral waters, and it is, moreover, when accompanied by abundance of fluid, almost as readily eliminated. It must be remembered, in employing this drug, that it is not only essential, but of paramount importance, that the system be continually saturated, and flushed, so to speak, with water in abundance. Though some doubt its efficacy as compared with the ammonium, calcium, and potassium salts, it certainly is least depressing to both circulation and nervous system, and less irritating to the emunctories. In epilepsy it is questionable if the results desired are not those that accrue to toxicity rather than those of purely remedial character, for here free stimulation appears to inhibit prevention of paroxysms. But as a nerve-sedative purely, continued experience with sodium bromide invariably leads to greater and increasing favor on the part of both prescriber and patient, until the verdict ultimately becomes overwhelmingly positive.

Bromalhydrate in large doses is a poison of great intensity, death rapidly resulting from paralysis of heart and sometimes of respiration also, preceded by minutely-contracted pupils, marked dyspnœa, and general convulsions. It lowers blood-pressure by powerfully depressing the circulation and vasomotor centres; it is equally depressant to the cord, especially the motor columns thereof. When employed in hypnotic doses, sleep is induced by direct action on the cerebrum, causing brain-anæmia. Larger, but non-toxic, doses induce distinct lowering of body-temperature. Like chloral, to which it was expected it would prove an analogue, it is antiseptic; and it is likewise markedly and painfully irritant to mucous membranes and raw surface. It is eliminated by the kidneys but slowly, and in the form of urobromic acid.

Bromalin, inasmuch as it contains only about half as much bromine as potassium bromide, requires to be given in large doses, but its effects are supposed to be identical with the latter. It is claimed, moreover, that it is less prone to provoke unpleasant sequelæ; but clinical experience is not yet sufficiently ample to permit of drawing definite deductions.

Bromamide evinces its chief activity upon the cerebrum, which it materially depresses; hence its reputation as an hypnotic; nevertheless, it is inferior to many other drugs in this respect. In larger doses it is more markedly depressant, exerting its action upon the spinal cord, whereby it becomes an analgesic. In medium doses it stimulates the respiratory centres; but here, again, when pushed to the verge of toxicity, an opposite result accrues that may result in total paralysis. In small doses it influences the circulation but little; but in larger depresses the heart, and, if increased, the action of the organ is entirely suspended. Thus it is a remedy far more powerful for evil than good, and furthermore there is little confidence to be placed therein, since, once exposed to air and light, chemical changes take place whereby it develops greater toxicity. A dose taken from one container to-day that appears harmless, if repeated a week later may prove dangerous. Until more is known of the product, and until

its manufacture and preservation can be encompassed by greater safeguards, insuring stability and uniformity, the drug is best relegated to the list of curious chemicals.

Bromamide reduces body-temperature without giving rise to the excessive sweating produced by other antiseptics; it is free from unpleasant symptoms as regards the alimentary tract. Caillé (Practitioner, London, May, '92).

Bromoform is best known for its anæsthetic properties, but is sometimes applied to relieve the pain accruing to certain morbid ulcers, and here appears to be both an antiseptic and a local anæsthetic. After inhalation it may be detected in the form of hydrobromic acid in the urine. It is highly toxic, moreover, and induces symptoms of collapse, accompanied by great weakness, cyanosis, dilated and fixed pupils, and coldness of extremities, but seems to be easily eliminated from the system under the use of stimulants and tepid baths.

Bromol has a peculiarly disagreeable, pungent odor, and a sweetish, astringent, but not unpleasant taste, and, as may be imagined from its derivation, is powerfully antiseptic. It is unfortunate it should have secured a designation that is likely to cause it to be confounded with bromal. It has been employed both externally and internally, but definite data are lacking regarding physiological properties when introduced into the living economy. Bearing in mind its source, it should, for the present at least, be regarded as a drug demanding great caution in its employment. It is said to be excreted by the kidneys as tribromphenolsulphuric acid.

Poisoning by Bromides.—It has repeatedly been denied that bromides *per se* ever induce fatalities, but the evidence already deduced is proof sufficient of their dangerous character. Careful examination of literature also reveals the fact that fatalities are, by no means, of infrequent occurrence, and the suspicion is forced that many deaths that should have been ascribed to the toxic action of bromides have been ignored or mistakenly ascribed to the malady for which the drugs were prescribed.

Hameau reports case of a young woman who took four and one-half pounds of bromide during ten months, and while in a condition of cachexia with yellowish skin, copper-colored eruption on forehead, colic, gastralgia, etc., suddenly became greatly prostrated; had delirium with profuse sweats, followed by death in four days. H. C. Wood ("Principles and Practice of Ther.," '94).

Literature of '96 and '97.

Case of a woman who took five pounds of potassium bromide in less than a year, and, while having very pronounced symptoms of brominism, was seized with delirium and suffered from hallucinations of sight and hearing; declared she was being poisoned. Death followed. Eigner (Wiener med. Presse, Nos. 25-34, '96).

A man suffering from neuralgia had been in the habit of taking potassium bromide in 1- and 2-drachm doses. It did not appear to have produced the usual symptoms of bromism, but may have caused the palpitation of heart frequently complained of. The night of his death he complained of being very cold, and suddenly, after two deep gasps, expired. The medical practitioner who was sent for at inquest stated that he found the deceased quite dead, his mouth wide open, the eyes half-closed, and the pupils somewhat dilated. A bottle containing the drug was on the table, and examination showed it was pure bromide of potassium. Death was attributed to failure of the heart's action caused by taking the bromide. This case is interesting for several reasons: It proves, in a marked manner, the

danger of taking any drug, however harmless it may be, in large and repeated doses without the advice of a medical man. As this bromide is constantly administered in large and repeated doses, the action of its basic constituent should always be borne in mind, and, if signs of its depressant effect are observed, its use should be abandoned. Many secret remedies for "fits" contain this drug in large quantities, and it is evidently desirable that the public should be warned that their use is not unattended with danger. Editorial (Lancet, London, Apr. 4, '96).

A number of deaths can only be explained by the inordinate use of bromides. The patients sink into a condition of apathy from which they cannot be roused. Have seen three autopsies and have knowledge of five more wherein the excessive use of bromide salts gave rise to fatality. Janeway (Amer. Medico-Surg. Bull., May 16, '96).

Treatment of Bromism. — This consists, first of all, in suspending the drug; next in promoting excretion by the emunctories, the kidneys and skin especially, coupled, if need be, with supporting treatment to heart and general circulation, and endeavors to restore to normal the *status* of the nervous system. The mercurial salts are often of marked value, especially the iodide as found in combination with arsenic in Donovan's solution. Occasional purges by large doses of calomel are also very effective, and, when given to the amount of 30 to 50 grains at bed-time, this drug is not only without depressing after-effects, but tends to stimulate the kidneys and emunctories to renewed activity.

Theoretically, pilocarpine, or jaborandi, would be considered of use; but to an economy already generally depressed, with circulation and nervous system suffering from the poison, these might prove boomerangs; atropine and belladonna are much more preferable and reliable.

Therapeutics.—Very little that is new has accrued to the use of bromides of late years, except as has already been pointed out in discussing their physiological action and relations. Originally introduced as alteratives, their value in this respect seems to have been lost sight of, and they are employed chiefly as antispasmodics, hypnotics, anaphrodisiacs, sedatives, and to some slight degree as analgesics.

Fever.—By their action on the circulation and cord they often prove exceedingly valuable aids in the treatment of febrile maladies, especially of children, and particularly when employed in conjunction with gelsemium or aconite; the same is true, also, in the management of acute brain affections.

Epilepsy. — Their greatest employment, however, has been in the management of epilepsy; but, despite the weight of contrary evidence, the writer has never observed any lasting benefit to accrue to their use in any form of this malady, for, while they may decrease the number of paroxysms, they positively never afford other relief, and many times the condition resultant upon their use is worse than before treatment began. It might be assumed that the foregoing obtained solely as a matter of coincidence; but, unfortunately for such an hypothesis, this experience is by no means solitary or unique. Again, at least 5 per cent. of epileptics cannot bear any bromide, even in small doses.

Use the three salts in epilepsy—ammonium, potassium, and sodium — in combination in doses of from 40 to 80 grains morning and evening. In strictly nocturnal seizures one dose at night only. Treatment should be persisted in for at least three years. Arsenic is a valuable adjunct to the bromides.

Eulenberg (Ther. Monat., Nov., Dec., '92).

Large doses of strontium or potassium bromide are demanded in epilepsy. Begin with 60 grains daily and increase gradually to four times the amount (240 grains). Large doses are beneficial only when the maximum is reached. Féré (Revue de Méd., Mar. 10, '93).

When a bromide is given in conjunction with borax the action is better than with either salt alone. Alexander (Liverpool Medico-Chir. Jour., July, '93).

Nothing superior to bromides, alone or in association, has been evolved in the therapeutics of epilepsy. Gray, Pritchard, and Shultz (Annual, vol. v, '94).

Twelve cases of epilepsy: 8 male and 4 females, of ages ranging from 10 to 50 years; no predisposition, no syphilis. In 4 the fits occurred at least once a week, in the other 8 at intervals varying from 1 to 8 weeks. Bromide of strontium, 20 grains, with 5 to 10 grains of bromide of ammonium or sodium, were given night and morning, largely diluted with water. Strontium increased rapidly to 60 grains twice daily, when the smaller doses failed to control the attacks. The majority took the latter drug without any depression, but generally with the production of acneic rash on face. Fowler's solution of arsenic added to the mixture controlled the rash and increased appetite. The number of attacks in all cases was materially decreased, and in 8 there was no return after intervals of from 4 to 16 months. Roche (Med. Press and Circ., Aug. 12, '92).

It has been recommended to combine adonis vernalis and codeine with bromides in the treatment of epilepsy, but careful investigations on the part of many observers are not at all assuring in this direction.

Literature of '96 and '97.

The cures do not appear to be in any way effected save by the bromides alone, and the combination does not, in any way, prevent the complications and disagreeable symptoms which arise from the use of bromide salts. Taty (Lyon Méd., Dec. 29, '95; *ibid.*, Jan. 5, 12, '96).

Chorea. Convulsive and Paroxysmal Maladies. — The bromides have also been extensively employed in chorea, but without any great measure of success. They are, however, often most effective in hysterical seizures, asthma, the milder forms of whooping-cough and puerperal eclampsia and infantile convulsions; also have been lauded in tetanus, laryngismus stridulus, and seizure that sometimes follow thyroidectomy.

Stridulous laryngitis in children is, doubtless, due to inflammation of the larynx, the spasms being the sole danger. Here 60 to 70 grains of bromide of potassium should be administered daily, even to a child so young as four and one-half years; intubation or tracheotomy may be added in menacing cases. Huchard (Revue Gén. de Clin. et de Thér., No. 38, '94).

The excitability of the nervous system and convulsive symptoms that follow thyroidotomy may be diminished and suppressed by the use of potassium bromide. Gley (La Sem. Méd., Apr. 13, '92).

The symptoms of tetanus in dogs caused by total thyroidectomy can be overcome by large doses of potassium bromide; fifty animals operated upon were thus kept for two years, and two more for six years. Canizzaro (Deut. med. Woch., No. 184, May, '92).

Heart Disorders.—In cardiac neuritis and in angina pectoris the bromides have been recommended, though it is admitted, as regards the latter malady, that only excessive doses can be of benefit; in the former the most that can be expected is to obtund the reflexes, and this is equally true of their use in Ménière's disease and attacks of nervous vomiting.

Cardiac neuritis, when due to reflex excitation of the pneumogastric, may be

treated by large doses of bromides. Lancereaux (Le Bull. Méd., July 27, 31, '92).

The value of bromides in doses less than 60 grains in angina pectoris has been exaggerated, and the larger doses are, in the main, objectionable. Huchard (Univ. Med. Mag., May, '92).

In acute attack of Ménière's disease efforts should be made to subdue the excitability of the nerve-centres. Bromide of potassium, 10 to 20 grains three times daily, and rest in the recumbent position usually suffice to relieve. MacKenzie (Brit. Med. Jour., May 5, '94).

A girl, 8 years of age, of neurotic parentage, had curious attack of vomiting at intervals of about six weeks each; the vomited matter was highly acid, and there was a burning sensation in the stomach. Potassium bromide, and also chloral, per rectum, proved useful. Snow (N. Y. Med. Jour., July 1, '93).

Dysmenorrhœa. — Sir James Y. Simpson was wont to rely upon potassium bromide in connection with guaiac and magnesia for the treatment of functional dysmenorrhœa, and the sodium salt in conjunction with gelsemium has proved most beneficial in the hands of many. Bromides, too, are often of value in the casual forms of mental alienation that appear in highly-nervous females and are ascribed to the menstrual function.

Administer large doses of bromides—sodium, potassium, and ammonium salts—in combination, every night for a week midway between the periods in dysmenorrhœa; a hot bath to be taken for six nights before the expected flow. Oliver (Edinburgh Med. Jour., July, '92).

There is an intimate relation between menstruation and insanity. The prognosis in menstrual insanity is favorable, and the treatment resolves itself into the use of general and ovarian sedatives, specially the bromides. Ball (Journal de Méd., Mar. 20, '92; Annales d'Hypnol. et de Psych., Feb., '92).

In four cases the administration of bromide of sodium induced erection and seminal emissions. The same drug produced orgasm in a girl; and in a boy suffering from seminal emissions as the result of masturbation the trouble was increased. Monroe (Med. Stand., May, '91).

Bromide of potassium is specially to be recommended in neuralgia. Hirshkron (Internat. klin. Rund., '93).

Infectious Diseases.—Especially in the exanthemata and infectious diseases the bromides often prove of the utmost value if given in small and often-repeated doses, in allaying nervous excitement and combating insomnia.

Bromal has given good results in diphtheria when dissolved in glycerin (1 to 25) and applied topically to throat. Also internally in cholera infantum, in doses of from $^1/_{12}$ to $^1/_5$ grain. Rademaker (Lancet, London, Oct. 10, '91).

Bromoform is effective not only as an antiseptic, but it controls morbid secretion. It may be successfully employed in tubercular and other ulcers of the throat, in which it appears to act as an analgesic. S. Solis-Cohen (St. Louis Med. and Surg. Jour., Aug., '91).

In five cases of whooping-cough there was marked improvement under bromoform. Was given to a child 2 years of age in 2-drop doses. Twenty to 60 drops given in the course of five days usually lessened the number of paroxysms. Best given in syrup of gum arabic. C. W. Earle (Jour. Amer. Med. Assoc., Sept. 26, '91).

Reflex hemicrania from carious tooth relieved in three hours by a 15-grain dose of bromamide; premenstrual headache in like manner relieved in two hours. Relieves rheumatic pains. Best given in capsules, suspended in fluid, or dry on the tongue. Caillé (N. Y. Med. Jour., Feb. 20, '92).

Gout.—In some gouty people Brunton has found 20 grains of potassium bicarbonate with 10 to 20 grains of potassium bromide useful, taken when the feeling of irritability comes on. It frequently soothes, and, furthermore,

has the effect of lessening worry even in those who are not irritable.

Brunton also finds potassium or sodium bromide and sodium salicylate of value in the irritability of temper that is sometimes a precursor of headache, and likewise in heart disease. But bromides are contra-indicated in the cardiac depression that accrues to an alcoholic or opium debauch, and moreover are most dangerous. Such are cases requiring bread and are offered stone; the already-depressed heart and nervous system demand toning up and stimulation, whereas the bromine preparations make the patient worse.

G. Archie Stockwell,
(Central Staff).

BRONCHIAL TUBES, FOREIGN BODIES IN. See Trachea, Foreign Bodies in.

BRONCHIECTASIS.

Definition.—A more or less uniform dilatation of the bronchial tubes, of one or both lungs, which may be localized or extend to the finer ramifications.

Varieties. — The dilatation may be *cylindrical,* involving the medium-sized tubes and, less frequently, the smaller bronchi and bronchioles, or *saccular,* the caliber of limited portions of the bronchi being enlarged, and forming bag-like cavities of various dimensions. "Bronchiolectasis" is a term proposed by Kanthack for those cases in which only the bronchioles are involved.

Literature of '96 and '97.

Case of multiple bronchiolectasis. The diagnosis made during life was broncho-pneumonia. After death the lungs were found dotted with small bullæ, and similar cavities were revealed throughout the organs by sections; in places there were areas of collapse. Microscopical examination showed patches of broncho-pneumonia and small-celled infiltration about the bronchioles, but no signs of tuberculosis; the broncho-pneumonia he thought was the first lesion. H. Tooth (Brit. Med. Jour., Nov. 7, '96).

Symptoms. — In practically all the cases of bronchiectasis there is a history of prolonged bronchitis, of pleurisy, catarrhal pneumonia, broncho-pneumonia, or some other acute pulmonary disorder. A few follow the inhalation of some foreign body of sufficient size to occlude a bronchus. When bronchiectasis follows bronchitis, the symptoms of this disease assume a modified character: the cough becomes more severe and paroxysmal and the amount of expectorated material is greatly increased. This copious expectoration—which may reach over a pint a day—especially occurs early in the morning or after a sudden change of posture, even when the patient is in bed. At first giving off a sour odor, it gradually becomes fœtid, and this fœtor becomes so marked that the atmosphere around the patient is almost unbearable. In cases of long duration the expectoration is brownish and, when examined microscopically, is found to contain Charcot-Leyden crystals and masses or bundles of fatty-acid crystals. Various kinds of bacteria, leptothrices, etc., are also found, some of which are of external origin. The tubercle bacillus is seldom detected unless the patient be concomitantly suffering from tuberculosis of the lungs.

The temperature, which during the presence of bronchitis alone may have been normal or slightly above the normal level, now shows a tendency to rise near evening. The curve is irregular and may reach 105°. When the disease follows pulmonary disorders, attended with pyrexia, this is increased with the accession of fœtor. As a result of septic

absorption, manifestations simulating those of hectic, as observed in consumption, usually occur, and the patient may succumb. Pulmonary gangrene is not an infrequent complication and promptly leads to a fatal ending in the vast majority of cases. Intense pain in the head in these cases indicates involvement of the meninges, while the cerebral pressure induced may give rise to hemiplegia, athetoid movements, and finally stupor. This complication occurs in about one-half of the cases.

In children the disease is frequently the result of whooping-cough or of broncho-pneumonia, the mechanical origin of the dilatation of the bronchi being mainly due to repeated and forcible coughing, the weakened resistance of the bronchi through inflammatory softening causing them to yield to the undue air-pressure. This is especially the case when inflammatory disorders involving the bronchi have repeatedly occurred in the patient. Cases of broncho-pneumonia or chronic bronchitis in which recurrences have repeatedly shown themselves are therefore the most prone to bronchiectasis.

When the cylindrical dilatation is not great, the physical signs do not differ markedly from those observed in the causative disorder. But a comparative point of value is that furnished by examination during a fit of coughing, when marked gurgling may usually be noticed, which gurgling varies according to the amount of accumulated secretion. During normal and even deep respiration increased roughness as compared to the ordinary signs of the primary disorder may be present; but the information thus obtained is not sufficiently distinctive to warrant for this symptom more than a confirmatory position among the signs present. Loud gurgling during coughing and fœtor of the sputum are conjointly, however, strong evidences that bronchiectasis is present.

When distinct saccular bronchiectasis is present, the characteristic signs of pulmonary cavities are pre-eminent, but most marked in the majority of cases at the base instead of the apex of the lung involved. Cavernous and amphoric signs are usually marked. The disease being unilateral in a larger proportion of the cases, confusion with tuberculosis is possible when the left side is involved, and when the bronchial dilatation is not confined to the base.

Literature of '96 and '97.

The disease is more often in one lung than in both, though it is sometimes bilateral. The physical signs in a typical case of bronchiectasis, especially where there are a considerable number of sacculated or large, dilated bronchi are somewhat easier to diagnose, but the difficulty of diagnosis is to distinguish these cases from those of a phthisical nature. It must be remembered, however, that we very rarely find a primary basic phthisis, phthisis being nearly always secondary to previous trouble at the apex. Where there are only basic signs and dullness associated with copious and fœtid expectoration, it is almost sure that such a case is one of chronic induration of the lung following on bronchiectasis, and where there is very marked clubbing of the fingers the diagnosis is confirmed. Habershon (Clinical Journal, Dec. 2, '96).

When bronchiectasis is due to the presence of a foreign body, it is caused by the violent cough induced, which gives rise to undue pressure within the tubes. The excessive coughing may also cause free portions of the lung to become dilated. The same condition may be brought about by stricture or compression occurring in the course of morbid processes which mechanically inter-

fere with the free passage of air through the tubes. It may, in this manner, complicate phthisis and aneurism.

Diagnosis.—The conditions for which bronchiectasis is apt to be taken are pulmonary tuberculosis and circumscribed empyema.

Pulmonary Tuberculosis.—In this disease tubercle bacilli are usually found in the sputum. The lesions are located at the apex of either lung, generally the left; while in bronchiectasis they are more disseminated and involve the base. In tuberculosis there is a history of hæmoptysis, gradual loss of flesh and strength, and the cough is not inclined to be paroxysmal. This disease occasionally acts as the exciting cause of bronchiectasis, however, and the apex may be the seat of bronchial dilatation.

Case in which, at post-mortem examination, the right lung was found adherent at its apex. This portion of the lung was not indurated, but elastic and soft, not crepitating or creaking under the knife. Upon section of the superior quarter of the lung a multitude of cavities were disclosed with rigid walls, all of which communicated with a bronchus. Bensaude (Bull. de la Soc. Anat., Paris, No. 11, '94).

Literature of '96 and '97.

Bronchiectasis is not a common complication of phthisis. Only witnessed a few times out of nearly eight hundred post-mortems performed on tubercular cases during the last few years. Habershon (Clinical Journal, Dec. 2, '96).

Circumscribed Empyema.—In this disease there is a clear history of acute onset, with pleuritic symptoms, and a sudden evacuation of large quantities of pus. The dyspnœa is not usually of long standing and generally comes on with comparative suddenness. Distinct dullness over the purulent area serves to indicate the true condition present.

Etiology.—When chronic bronchitis is the primary cause of bronchiectasis the patients are usually past middle life, with the exception of the form due to foreign bodies, which may invade the respiratory tract at any age. Dilatation of the bronchi is more likely to present itself during early middle life. As stated, it usually follows primary disorders of the lung, but it is most prone to do so in persons weakened by diathetic conditions or untoward habits. Under the former may be classed alcoholism, syphilis, gout, and rheumatism. Under the latter alcoholic conditions tending to mechanically induce an increase of the bronchial air-pressure by interfering with the free egress of the atmospheric current; laryngeal paralyses; laryngeal, infralaryngeal, and tracheal hypertrophic processes; neoplasms or aneurisms compressing the trachea or the larger bronchi; foreign bodies in any part of the inferior respiratory tract, etc., are as many possible causative factors. Exposure to cold and wet, dust, irritating gases, etc., tend to increase the local disorder by promoting the tendency to local congestion.

Literature of '96 and '97.

Among the further causes in children producing bronchiectasis, it might be stated that adenoids have some influence on the affection: an influence only, however, in children by predisposing the child to attacks of cough and bronchitis.

Case of marked fibroid induration and extensive bronchiectasis due to the plugging of a bronchial tube by the impaction of a tooth. Habershon (Clinical Journal, Dec. 2, '96).

Prognosis.—Bronchiectasis being, as a rule, a secondary disorder, its prognosis depends, to a great measure, upon that of the disease acting as cause. Again, the degree of dilatation induced

—whether it be cylindrical, circumscribed, localized, or diffused—bears an important influence upon the course of the disease. A slight modification of the bronchial lumen does not necessarily preclude the enjoyment of practically good health; when, however, the lumen of the tubes is markedly increased or studded with saccular dilatations, the infectious processes already described are apt to present themselves at any time and greatly aggravate the danger. Progressive emphysema and gangrene are among the complications to be expected. Dilatation and hypertrophy of the right ventricle is frequently observed in cases showing a history of pertussis. On the whole, well-marked bronchiectasis does not tend toward recovery.

Pathology. — The bronchial tube in some cases is only temporarily dilated; this occurs in children after whooping-cough or acute pneumonic disease. It is far more common, however, when there has once been dilatation, to have repeated attacks of inflammatory trouble, and the dilatation continually increasing year by year. The effect on the bronchial tubes themselves is probably first of all swelling, sometimes observed in the mucous membrane, which becomes velvety in appearance; the muscular coat of the smaller bronchi then becomes tumefied and its resistance is weakened. Owing to the frequent attacks there is a considerable fibrosis or peribronchial thickening around these dilated bronchi. In some cases, however, instead of hypertrophy of the small tubes there is thinning and dilatation. When the bronchi are large this dilatation is very striking. On post-mortem are found large cavities with many valvular reflections of the mucous membrane,—an exaggeration of the normal condition of the bronchial tube; so that a large cavity seems to be partitioned off by these valvular septa, especially in the sacculated form of bronchiectasis; there is a small opening, which is the bronchial tube leading to it.

Not only are the bronchial tubes affected, but the surrounding area of lung is also involved. It is affected in two ways: First an extensive inflammation spreads from the peribronchial connective tissue, which is continuous with the whole frame-work of the lung. This tissue sends out delicate filaments between the alveoli of the lung, and this net-work is again continuous with the pleura and with the septa passing in from the pulmonary pleura. This frame-work becomes indurated, the chronic inflammation round the tubes continues until there is an interstitial fibrosis,—an interstitial thickening of the pulmonary substance round the dilated bronchial tubes. But such a lung with dilated tubes is especially liable to repeated attacks of catarrh or catarrhal pneumonia; therefore specimens sometimes show evidences of acute catarrhal pneumonia, but more often those of a chronic indurative pneumonia. The consolidation due to chronic pneumonia is distinct from the first, and is characterized by a reticular thickening, or fibrosis, of the connective-tissue elements forming the frame-work of the lung. The contents of the alveoli are in many cases consolidated, and the appearance is not of recent, but of organized, exudation. When stained with eosin and hæmatoxylin, the eosin picks out the blood-vessels. The centre of the aveoli may thus be shown to be filled with small cellular elements and small blood-vessels, indicating that it is becoming fibroid and organized.

As the disease proceeds there occur further complications, which end sometimes in death. In many cases ulcera-

tion of the bronchial tubes supervenes. In the bronchial tubes the retained secretions become putrid, full of micro-organisms, forming the foul sputum characteristic of such cases. Very often this goes on till ulceration takes place, and when once ulceration occurs any form of septic disease as a final cause of death may appear. Very common causes are found to be septic pneumonia and septic abscess in other parts of the body. Above all, abscess in the brain seems to be one of the commonest causes of death occurring in such cases. Besides septic pneumonia, death may take place from acute catarrhal pneumonia, especially where the patient has been subject to chronic bronchitis associated with rather frequent attacks of acute broncho-pneumonia. (Habershon.)

Case of bronchiectasis with metastatic intra-encephalic suppuration in a man, 23 years old, who presented the characteristic cough and fœtid expectoration. Symptoms of meningitis developed and led to a fatal ending. Upon post-mortem examination, in addition to the dilatation of the bronchi, an accumulation of pus, of fœtid odor, was found in the subarachnoid space below the inferior vermiform process of the cerebellum; and also in the left lateral ventricle, in the posterior horn of which a small area of ulceration was found. The adjacent white substance was the seat of a yellowish, gelatinous area, of irregular outline. Péron (Bull. de la Soc. Anat., Paris, No. 13, '94).

Literature of '96 and '97.

Autopsy in a case of fibroid-lung bronchiectasis.

Lung: Showing fibroid induration. The upper lobe is uniformly solid, gray, and very firm. The middle lobe is not so firm. The lower lobe is congested and shows an area of fibrous induration in the lower part. Extending through these solidified portions are tubular bronchiectasic cavities with blood-stained walls.

Brain: Section through the right hemisphere of the brain about the paracentral convolution, in the upper part of which is an abscess-cavity the walls of which are irregular.

The association of brain-abscess with bronchiectasic cavities has frequently been noted. Williamson has recently reported that out of 39 cases of brain-abscess, 17 were associated with putrid bronchiectasis. Livingood (Johns Hopkins Hosp. Bull., Dec., '97).

Treatment.—A very important point in the treatment of bronchiectasis is to see that the cavity or cavities are frequently emptied. This can generally be effectively done by partially inverting the patient, at first two or three times a day, and later once a day. The simplest plan to adopt is for the patient to hang himself over the edge of the bed or couch so that his legs rest on it and his body is supported by his hands on the floor. This partial inversion is followed by cough and the evacuation of a considerable amount of offensive sputum. (Hector Mackenzie.)

The above sufficiently illustrates the inadvisability of giving remedies such as narcotics to arrest the spasmodic coughing: a mechanical device employed by nature to rid the dilated areas of accumulated purulent liquids. The so-called expectorants are useless, and the disinfectant aromatics but serve to momentarily check the fœtor of the breath, whether applied by means of respirators or atomizers. The vapor or spray so produced hardly penetrates beyond the trachea. The medicaments employed must reach the diseased areas either directly or through the blood-current.

The intralaryngeal injection of antiseptic liquids recommended by Grainger Stewart accomplishes to a degree the desired result in the small proportion of cases in which the dilatation only involves the larger bronchi.

A drawback connected with methods in which professional dexterity has to play a rôle is that the patient does not always receive as many applications as his condition would require in order to obtain the best results. Measures which the patient can carry out himself are therefore always to be preferred.

A method at once beneficial and easily carried out is to resort to the prone position, as described above, and to administer drugs which are eliminated by the lungs. The allyl compounds are very effective, and Vivian Poore has recommended garlic as especially valuable. A "clove" of garlic is to be chopped up and boiled in beef-tea and given three or four times a day. Hector Mackenzie found garlic most useful for diminishing the fœtor of the breath and recommends in the case of children the syrup of garlic of the United States Pharmacopœia. A drachm of this may be given to a child three times a day with an equal amount of syrup of Tolu. For an adult 2 or 3 grains of powdered garlic may be given in a cachet, or 2 to 4 drachms of the syrup.

The balsams also possess curative properties, but do not reach the diseased areas when applied by means of the atomizer.

Molle has observed rapid improvement, amounting practically to cure, in children by the use of the following mixture:—

℞ Eucalyptol, 10 parts.
Creasote, 25 parts.
Tincture of benzoin, 50 parts.
Copaiba, 80 parts.
Oil of sweet almonds, enough to make 200 parts.

Thirty drops of this mixture are injected into the rectum, in a little milk, and the amount is gradually increased to one or two teaspoonfuls. One injection daily is sufficient. The child experiences a temporary burning sensation to which it rapidly grows accustomed. If this treatment is persisted in for months, all the symptoms are said to diminish, and the general condition is correspondingly improved, even proceeding to a cure.

The ordinary commercial coal-tar creasote is highly recommended by Arnold Chaplin, the aim being to empty the dilated tubes of the fœtid material and to prevent their becoming filled again. According to this author, and the argument is sustained by the excellent results obtained, in order to fulfill the qualifications given above, a drug is needed which, while it is strongly antiseptic, must at the same time be pungent and acrid enough to induce violent expulsive efforts. These conditions are, according to Chaplin, fulfilled by the common commercial coal-tar creasote. The mode of application is as follows: A room about seven feet square by seven feet high must be obtained, and this must be rendered tolerably air-tight. It is well to have the room on the top of the house, or away from it, as there will be less chance of the vapors generated from the creasote causing annoyance to those living in the house. In the centre of this room a small stand about $1\,^1/_2$ feet high is placed, and on this an ordinary spirit-lamp which admits of being raised or lowered. Over the spirit-lamp, on a tripod, an enameled-tin dish is placed, and into this is poured about half a pint of the coal-tar creasote. The creasote is heated until the dense pungent fumes are given off. The patient, clothed in an old dressing-gown, is placed in the room as soon as the lamp is lighted. As soon as the fumes begin to come off, an urgent desire to cough comes on, and soon the cough becomes

more or less incessant, and attended with the expulsion of large quantities of phlegm. After the sitting has lasted from a half to one hour the patient may leave the room, and wait until the next day before taking another sitting. This should go on steadily from day to day for two months. For the first day or two not much benefit will be noticed, but very soon the expectoration becomes reduced and the odor less disgusting, and before very long the patient, who before was unbearable, is able to mix with his friends, and, unless he has a fit of coughing, his breath is quite free from smell. After two months the patient seems practically cured, but he must take a sitting at least three times a week if he will keep his expectoration free from odor. With the cessation of the fœtor comes increased appetite and strength.

Children do not bear the treatment well, and the benefit to them is not nearly so marked. The method is an unpleasant one, however, and it requires all the persuasive powers of the physician to keep the patient up to the necessity of going on with the application of the drug; but after a few sittings patients generally become used to it. Secondly, the fumes of the creasote produce running and smarting of the eyes and nose; but this can be prevented by introducing two plugs of cotton-wool into the nostrils and covering the eyes with a pair of glasses rimmed round with India rubber. Beyond these there are no drawbacks to the treatment, and it can confidently be recommended as likely to improve the condition of the patient if persevered in for sufficient length of time.

Literature of '96 and '97.

Creasote found of much value, administered in the form of carbonate of creasote, ½ drachm three times a day. Price Brown (Canadian Practitioner, Feb., '96).

Case in which ten minutes was the limit of the patient's endurance on the first day, owing to the violent paroxysms of coughing and nausea produced by the vapor; yet he soon got used to it, and in the course of a day of two was able to stay in the full time—one hour—with very little discomfort. The beneficial effect was immediate. After the first inhalation of ten minutes the cough was improved, the expectoration and breath less foul, he slept better, and the temperature, which had been rising steadily for a day or two, began at once to fall. C. Brian Dobell (Brit. Med. Jour., June 20, '96).

Surgical measures have been resorted to with the view of reaching, by external incision and draining, the cavities containing fœtid accumulations. But the fact that the latter are very rarely localized within a restricted area at once condemns so severe a remedy, that involves complications, especially pneumonia, which may soon cause the patient's death. The only kind of case in which it might in the least be warrantable is where the presence of but a single bronchiectasic cavity can absolutely be established by physical examination, and even then only when it is near the surface.

Case in which pneumotomy was performed for bronchiectasis of the apex of the right lung in a patient aged 43 years. An opening in the second intercostal space was first made into the pleura with the knife, and the Paquelin cautery used as in the previous case. Evacuation of fœtid pus was thus obtained. A drainage-tube was introduced and iodoform-gauze packing used to stimulate granulation. The recovery of the patient was complete in fifteen days. A slight dullness upon physical examination remained. Hofmokl (Cent. f. Chir., Aug. 19, '93).

Literature of '96 and '97.

Case in which recovery occurred after three operations, in a girl aged 18 years. The physical signs showed that the lesion was in the lower lobe of the right lung. The largest trocar of Dieulafoy's apparatus was passed into the chest in the seventh interspace behind, and eventually thick pus with gangrenous *débris* was obtained. A flap of the skin was then raised and portions of three ribs were resected. The thickened tissue now exposed was divided by the thermocautery until a cavity was laid open. Gangrenous material escaped. Multiple cavities were then opened up by the cautery, and it was thought that the openings of dilated bronchial tubes could be felt. After the *detritus*, etc., was cleared out a cavity remained about the size of a turkey's egg. The patient expectorated about this time a most horribly offensive material. Two drainage-tubes were put in. The patient now steadily improved, and in a month's time was sent into the country. She continued to do well for four months. Later the expectoration increased, amounting to from 30 to 50 cubic centimetres in the day, and the general condition became worse. A second operation was therefore undertaken about nine months and a half after the first one. Some more cavities were cleared out, scraped with a Volkmann spoon, and packed with iodoform gauze. There was troublesome vomiting after this operation. A counter-opening had to be made fourteen days later below the right breast, and a large drainage-tube was passed through. The patient now began to improve again. The drainage-tube remained in for four years. Twelve months later a cutaneo-bronchial fistula remained, and an operation was performed for its closure with success. Two years and a half afterward the patient was in excellent health. It was thought that the air penetrated into the right lower lobe, and that this part of the lung had again become permeable. Three or four times a day she had a moderate attack of coughing, with the expectoration of a clear and odorless fluid. This probably came from dilated bronchi in the neighborhood of the diseased focus. The expectoration was diminishing. Duret (Arch. Gén. de Méd., Jan., '96; Brit. Med. Jour., Feb. 22, '96).

CHAS. E. DE M. SAJOUS,
Philadelphia.

BRONCHITIS.

Definition.—An inflammation of the mucous membrane of the bronchi, usually including the trachea. It occurs as a primary affection or as a feature of many general diseases, especially the exanthemata.

Varieties.—Bronchitis may be subdivided into four distinct forms: the *acute*, in which the inflammatory process is more or less severe, but of limited duration; the *chronic*, in which organic changes in the mucous membrane maintain the activity of the final stage of the previous form; the *fœtid*, which differs from the two previous forms by the fœtid odor of the sputa; the *fibrinous*, or plastic, which is characterized by the presence of pseudomembranous casts formed in the bronchi.

Capillary bronchitis, so-called, being in reality a form of catarrhal pneumonia, will be treated under PNEUMONIA.

Acute Bronchitis.

Symptoms.—The course of acute primary bronchitis is fairly uniform. After exposure to cold, wet, or, oftentimes, to a close atmosphere, there is a feeling of malaise accompanied by chilly sensations or, more rarely, a pronounced chill. Within a short time slight fever develops, and coincidentally with this or shortly afterward a feeling of constriction or oppression beneath the sternum, which is intensified by deep inspiration.

Cough soon appears, but is at first dry, harassing, and not productive of relief. The temperature is usually elevated by a few degrees, but in children may rapidly rise to 102° or 103° F. In the course of twenty-four hours the cough

increases in severity, and by the end of that time is accompanied by the expectoration of a small quantity of glairy mucus produced only by inordinate effort. Gradually the cough becomes softer, the expectoration increases in amount and becomes opaque and finally yellowish. As expectoration increases the substernal discomfort lessens, the general feeling of illness diminishes, and the temperature falls to almost, if not quite, the normal point. After three or four days (sometimes sooner) the only symptoms remaining are frequent cough and a rather copious expectoration of yellowish-white muco-purulent material occasionally appearing as distinct clumps. The cough gradually lessens, the expectoration becomes less profuse, until finally the patient recovers completely after the course of a week or ten days.

In cases running a short course the mucous membrane probably becomes at once normal, although one attack of bronchitis frequently leaves behind it a certain susceptibility.

In children the initial general symptoms are more severe, the temperature elevation is greater, there is no visible expectoration until the fourth or fifth year, and vomiting is more frequent. Catarrhal pneumonia and atelectasis are frequent complications which may cause a fatal termination.

In the aged there is but little general disturbance at the outset, but the disease is apt to assume a subacute or chronic course, or the disease may end fatally in those enfeebled by advanced years or structural disease in other parts.

Physical examination in the early stages may show nothing or merely a few scattered sibilant râles. The respirations are slightly increased in frequency and a little more shallow than in health, except in infants, where the respiratory rate may be greatly increased. In the course of the first twenty-four hours there develop sibilant râles over areas on both sides of the chest, but especially in the spinal gutter. These râles rapidly shift their position and may be either produced or dissipated by the act of coughing. As the swelling of the mucous membrane increases or mucus is secreted in sufficient amount to materially alter the calibre of the larger tubes, sonorous râles appear. The out-pouring of mucus in larger amounts causes the appearance of moist, mucous râles in addition. In the absence of involvement of the pulmonary parenchyma percussion gives negative results. Palpation frequently, especially in children, reveals a coarse fremitus, which may be found to disappear after free expectoration or vomiting. The occurrence of complicating pneumonia or atelectasis produces the signs peculiar to those conditions.

Diagnosis.—The diagnosis presents no difficulty except in the determination of the primary or secondary origin of the trouble. The chief difficulty occurs in children, where time alone may be able to decide the question as to whether the bronchitis is "simple" or is the premonitory stage of pertussis or measles.

Etiology.—The causes may be classified as mechanical, chemical, infectious, and toxic. Of mechanical causes are the inhalation of dust, particles of food, etc.; of the chemical as the inhalation of irritating gases (such as chlorine); of infective, that occurring in the course of measles is the most marked. Among the toxic causes the poison of uræmia and possibly that of some of the infections must be included, the latter upon the theory that the inflammation is produced by the excretion of toxins by the respiratory tract.

Exposure to cold and damp is an etio-

logical factor probably acting by lowering bodily resistance and allowing the invasion of the mucous membrane by micro-organisms constantly present, but under ordinary circumstances impotent. The possibility of bronchitis being produced by the elimination through the respiratory passages of materials ordinarily passed out through the other emunctories cannot be certainly cast aside. Bronchitis has also been ascribed to the effects of ether, employed as an anæsthetic.

Bronchitis can no longer be regarded as a direct manifestation in the bronchial tract of a simple chilling of the peripheral circulation. Possibly the ciliæ of the tubes act less readily after chilling. Those of the nose, pharynx, etc., require some certain temperature—at present undetermined—for the proper exercise of their functions, or they may possess defective power of destroying the bacteria after chilling. Grün (Lancet, June 27, '91).

Case illustrating the relation existing between gout and bronchitis. The urine was loaded with urates. A typical gouty inflammation of the great toe supervened, and simultaneously the other symptoms subsided. Grant (Brit. Med. Jour., Feb. 2, '89).

Ether bronchitis is due to the aspiration of an undue quantity of saliva and mucus containing micro-organisms into the bronchi while the patient is anæsthetized. It could be prevented by insuring the escape of the saliva and mucus from the side of the mouth, by tilting the patient's head to one side. Grossmann (Deut. med. Woch., No. 29, '95).

Pulmonary symptoms following the administration of ether occur in series and are due to decomposed ether, which then gives off vinous alcohol and peroxide of hydrogen. Ether should be kept in small, entirely-filled, well-corked bottles, kept in cool, dark place. Remnants taken from partially-emptied bottles should never be used. Bruns (Berliner klin. Woch., Dec. 17, '94).

[This plan was adopted at my suggestion at University College Hospital with the best results for some years past. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

Bronchitis is frequently caused by the extension of diphtheria and erysipelas from the upper tract, but in that case cannot be considered as simple bronchitis.

Pathology.—The mucous membrane is injected, of a bright-red color, is thickened, and thrown into longitudinal folds. The surface is usually covered with more or less mucus or muco-pus. On section there is found leucocytic infiltration of the deeper layers. The epithelial layer shows active proliferation of the cells; goblet-cells are numerous and greatly distended; the cells of the mucous glands are swelled and granular; and the ciliated epithelial cells are seen to be shed in large numbers.

Prognosis.—In patients beyond the age of infancy and in those not debilitated by senility or serious organic disease recovery invariably occurs. In young children recovery is the rule; but the disease is of more gravity than in older children and adults, this gravity increasing inversely as the strength and age of the child. The chief danger in older children and in adults lies in the tendency to recurrence and consequent permanent change in the mucous membrane.

Treatment.—Treatment varies somewhat with the age of the patient. A few general directions apply to all ages. Equalization of the circulation and stimulation of all lagging emunctories are important early measures. In all cases purity of air, equable room-temperature (69° to 70° F.), and a slight excess of moisture in the air are essential.

The present view relative to the microbian origin of even common bronchial catarrhs is doing much to influence the choice of remedies in these affections.

The first step in morbid changes probably consists in a disorder of vasomotor innervation, which causes congestion and places the organism in a state of lessened resistance. If this view be correct, remedies are to be sought which shall improve rather than lower vasomotor innervation, on which the inflammatory changes so much depend. Editorial (Boston Med. and Surg. Jour., Mar. 7, '95).

In young infants the child should be clad rather more warmly than ordinarily, a cotton or woolen jacket should be applied, and the chest should be rubbed twice daily with camphorated oil or a mixture of equal parts of olive-oil and amber-oil or turpentine. A croup-kettle, to the water in which has been added compound tincture of benzoin (1 fluidrachm to 1 pint) should be employed for ten or fifteen minutes every hour or two, and in winter a broad, shallow pan of water should be kept in front of the source of heat in order, by its evaporation, to moisten the air of the room.

Great benefit from inhalations of warm vapor of wine of ipecacuanha, ten minutes at a time, three or four times a day. Morrell (Med. News, Sept. 8, '88).

Literature of '96 and '97.

In a number of cases where the inhalation of steam is recommended, dry, heated air would be far more efficacious, especially for those suffering from profuse expectoration, advanced in life. The real value of belladonna is due to its drying action in checking the profuse secretion, which is such a source of misery and danger to the aged.

The hot, dry chamber of the Turkish bath has been the means of aborting attacks of bronchitis, and deserves a trial; the patient to be driven in a close vehicle to and from the bath, and with mouth and nose protected with woolen comforter. I am fully persuaded that the indiscriminate recommendation of the bronchitis-kettle is a great error; it has contributed to the deaths of not a few to my own knowledge. Alexander Duke (Med. Press and Circular, Feb. 3, '97).

Ordinarily in the early stage a simple fever-mixture with the addition of a small quantity of ipecac will be all that is required. Of the febrifuges the citrate of potash with or without the addition of small doses of tincture of aconite in accordance with the fever and cardiac excitement will be found useful and simple. After the formation of mucus has started and the fever has subsided the chloride of ammonium, in doses of $^1/_4$ to 1 grain, should replace the fever-mixture.

Ordinarily no further medication is required except for the use of mild laxatives to keep the bowels thoroughly opened. In removing the extra covering on the chest care is to be taken that the change be not made too rapidly, but that small portions should be taken away at a time. If at any time marked oppression of breathing occurs from accumulation of mucus, the production of vomiting by a full dose of ipecac will cause prompt clearing of the tubes. In feeble children stimulants may be required, and where the heart's action is weak the carbonate or aromatic spirit of ammonium may, with advantage, be used instead of the chloride.

Apomorphine as an expectorant for infants instead of ipecac recommended.

℞ Apomorphine muriate, $^1/_6$ to $^1/_2$ grain.
Aquæ destil., 4 ounces.
Hydrochloric acid, 5 drops.
Simple syrup, 1 ounce.

M. Sig.: Take 1 teaspoonful every two hours. Collapse need not be feared, and the apomorphia disturbs digestion less than ipecac. Dembitz (Amer. Pract. and News, Dec. 22, '88).

Apomorphine, when administered on an empty stomach, produces vomiting much more readily than when administered after meals. When given hypo-

dermically, it is absorbed at once; when given on an empty stomach, it is absorbed more rapidly than when mixed with foods. Doses, as an expectorant, ½ to 1¾ grains, three times a day, after meals. Apomorphine made into ointment, 1 grain to the ounce of lard or lanolin, half the quantity rubbed into the chest at night, is a valued expectorant. This is of great practical importance, especially in the treatment of children. Expectorant effect in many by using the apomorphine as a spray. Murrell (Brit. Med. Jour., Feb. 28, '91).

Literature of '96 and '97.

Apomorphine, freshly compounded in acidulated mixture, is the best of all relaxing expectorants. In $^1/_{30}$-grain doses, at two or three hours' intervals, rarely fails to cause a free sero-mucous flow in twelve to thirty-six hours. Rest is an essential adjuvant. Codeine sulphate in $^1/_5$-grain doses, given independently, is the best sedative. Thomas Hubbard (N. Y. Med. Jour., July 18, '96).

In older children and in adults a preliminary hot foot-bath, to equalize the circulation and start the emunctories, is of value. The application of mustard poultices or turpentine stupes to the chest certainly gives relief and probably hastens cure. The use of a cotton or woolen jacket is not so important as in infants, but is of value. In those beyond the age of infancy ammonia salts can be used earlier in the disease, the chloride acting especially well in combination with compound licorice mixture. Usually no other medicine, save possibly laxatives, is required unless the latter part of the attack is prolonged, in which case small and frequently repeated doses of the oil of eucalyptus, gaultheria, or copaiba may be given in capsule.

Calomel rubbed up with sugar of milk, and given in doses of $^1/_6$ grain every two or three hours for four or eight doses. As the bowels are evacuated, the temperature declines and the other symptoms subside. De Holsten (La Sem. Méd., Jan. 10, '94).

In the aged it is important to sustain the general strength and especially to watch the condition of the right heart. Stimulants are usually necessary; and it is important to change the patient's position at short intervals in order to facilitate expectoration and to avoid the effects of gravity in causing congestion or atelectasis of dependent parts of the lung. Many expectorant drugs other than those mentioned above are employed, but it is a question whether their action upon digestion does not offset any possible good effect upon the bronchitis.

Oxygen-inhalations gave better results than injections of ether.

The hydrochlorate of quinine injected subcutaneously: a solution of equal parts of this agent and of glycerin and water.

In severe cases caffeine should be given subcutanecusly, with digitalis and alcohol as stimulants, and aconite avoided. Saint-Philippe (Jour. de Méd. de Paris, June 21, '91).

Case, *in extremis*, which, after inhalations of oxygen, was for a time comparatively comfortable, but died later, the supply of oxygen having run out. The question of temporary consciousness for signing a will or legal document is of interest. Langston (Brit. Med. Jour., Jan. 30, '92).

Series of cases in which oxygen-inhalations gave better results than injections of ether. Saint-Philippe (Jour. de Méd. de Paris, June 21, '91).

Literature of '96-'97-'98.

The use of oxygen in inhalation is sometimes objected to on the ground that it is not a really curative agent. This is true, but the inference that it is not worth giving is believed fallacious. It does often remove cyanosis, and a continuous condition of cyanosis must be an evil. It is probable that the inhalation of oxygen is generally commenced too late. Belief that its early use pre-

vents the advent of that pronounced cyanosis so often seen, and which, when it is once established, may be only slightly benefited by oxygen.

It thus gives patients an additional chance of life, and, furthermore, in most cases it gives marked relief. If we objected to give drugs in ailments unless they had a direct curative influence, our use of the pharmacopœial remedies would be very limited. D. J. Leech (Practitioner, May, '98).

Chronic Bronchitis.

Symptoms. — The onset of chronic bronchitis is usually insidious. It may follow immediately upon an acute attack which fails to subside or it may be gradual in its beginning, as in cases resulting from the long-continued inhalation of irritating material, such as metallic or crystalline dust or chemical vapors. Cough is the most prominent symptom. It is usually worse in the morning and after meals, but may give most trouble at night. It is usually accompanied by free expectoration of thick muco-purulent material of white, yellowish-white, or green color, at times twinged or streaked with blood. In a small proportion of cases there is no expectoration (dry bronchitis).

Cough and expectoration are for a long time the only symptoms, but in advanced cases (especially in elderly people) the right heart feels the strain of overcoming the increased tension in the pulmonary circuit, becoming dilated and causing circulatory embarrassment in the other organs (stomach, liver, and kidneys). Pulmonary emphysema, bronchiectasis, and asthma are the other sequelæ encountered. Exacerbations are readily excited, obstinate, and prone to leave increased organic change.

Bronchorrhœa, so-called, designates but an exaggerated flow of the bronchial secretions. These may be more or less watery, mucoid, or muco-purulent. As much as six pints have been expectorated in one day by a single patient.

On physical examination but little may be found in the "dry" form. Otherwise the findings will depend upon the extent and duration of the disease and the presence or absence of its consequences upon the remainder of the respiratory apparatus. In uncomplicated cases inspection gives no result. On palpation a strong fremitus may be felt from the vibration of mucus within the air-tubes. The bubbling and rattling of this material may be audible at a distance. On percussion there is no change unless the pulmonary structure is already involved or bronchiectases have formed. On auscultation loud bubbling and mucous or sibilant and sonorous râles are heard, which shift their position or may be entirely dissipated by cough. Sometimes the breath-sounds over one portion of the lung may be feeble for a time from partial obstruction by mucus to the entrance of air. The diagnosis prevents no difficulties if careful examination of the chest and of the sputum be made.

Etiology.—The chronic form is produced by the same causes as those mentioned under acute bronchitis acting for a longer time or frequently repeated. Insanitary surroundings, debility, and possibly inherited vulnerability are strong predisposing factors. Gout would seem also to be to some extent a predisposing cause. Mitral disease and enlargement of the tracheo-bronchial glands are contributing conditions because of their causing interference with the return-flow of blood and lymph from the bronchial tree.

Literature of '96 and '97.

Chronic bronchitis is very apt to be found in the two extremes of age. Not

only so, but in children acute bronchitis is frequently found, particularly in association with malnutrition and general debility. Commonly, too, it will be found that such children have enlarged lymphatics, are scrofulous or rachitic, and, if their bronchitis is of the chronic form, naso-pharyngeal lesions—such as adenoid vegetations or hypertrophy of the tonsils—are frequent. Among older persons the more common causes of chronic bronchitis, aside from lymphatic and scrofulous tendencies, are the gouty diathesis, insufficient action of the heart, emphysema, and asthma, and it is claimed by Bouchard that persons young or old who suffer from dilatation of the stomach very frequently have bronchitis. Dilatation very frequently produces lesions in the respiratory passages. Cantagrel (La Méd. Mod., Mar. 11, '96).

Acute bronchitis is very apt to become chronic in those persons who have a neuro-arthritic tendency; in other words, those who possess a tendency to gout and allied affections. Lyon (Revue de Thér. Medico-Chir.; Ther. Gaz., May 15, '97).

Pathology.—The appearance of the bronchi differs much in accordance with the duration and severity of the disease. In the mildest forms the mucous membrane is of a dull-red or slate color, thickened, and corrugated longitudinally. In more severe or long-standing cases atrophy of the mucous membrane is present in places; and this atrophy may extend to the deeper layers of the tubes. Consequent upon this atrophy there is dilatation of varying degrees (see BRONCHIECTASIS). When all of the coats are involved, infiltration and fibrosis of the surrounding connective tissue takes place, giving rise to one variety of fibroid disease of the lung. In elderly people the cartilaginous rings frequently undergo calcification, rendering the tubes rigid. Ulceration may occur, but is rare unless bronchiectasis has occurred or there is tuberculous or syphilitic infection. Other organs are involved secondarily, such as the right side of the heart (hypertrophy or dilatation) or the pulmonary structure (emphysema, fibroid disease).

Histologically sections of the bronchi show marked proliferation of the epithelial layer, or, in long-standing cases, great denudation thereof. New formation of connective tissue within the tissue proper of the bronchi and in the peribronchial connective tissue is seen to an extent corresponding to the duration of the disease. Commensurate with the fibroid change in the walls there is atrophy of the proper cellular elements.

Prognosis. — The prognosis depends greatly upon the surroundings and social condition of the patient. If removal from the chief causative factors (injurious occupations, unfavorable climatic conditions, etc.) is possible, the condition is curable except for possibly some permanent structural changes in the bronchial walls. Even with these the patient may be, to all intents and purposes, well. In the aged, in those already suffering from cardiac degeneration, or in cases with serious structural changes (bronchiectasis, emphysema) the outlook as to cure is unfavorable, and as to amelioration is doubtful.

Treatment. — The prime factor in treatment is the removal of the cause (insanitary surroundings, inhalation of dust, etc.). When the patient lives in a changeable or vigorous climate transplantation to an equable and mild region is of itself often sufficient to produce cure. Prophylactic measures to decrease the liability to exacerbations are important. The wearing of woolen underclothing, in order to prevent chilling of the surface; the practice of cool bathing on rising, in order to promote vascular tonus of the skin; the

correction of nasal and pharyngeal anomalies in order to do away with any "weak spots" favoring the "catching of fresh colds"—these are important elements in treatment.

At times treatment of the bronchial condition is best carried out by treatment of systemic faults or of an existing cardiac lesion in combination with more direct treatment of the bronchial catarrh. In many cases an important element is the "building-up" of the patient. One of the most valuable drugs is strychnine, which acts as a general tonic and is particularly valuable in stimulating the respiratory centre and toning-up the muscles, thus enabling the cough to be more effectual. Its value in the aged is very great.

Expectorant remedies are certainly of value, yet it must be borne in mind that they are very apt to upset digestion. Among them the ammonium compounds occupy a leading place. Where the expectoration is scanty and the sputum viscid, the chloride is to be used; where the right heart is laboring, the carbonate acts best; when there is indigestion and especially flatulent distension the aromatic spirit is preferable.

Iodide of potassium is of great value in liquefying the sputum, while its absorbefacient properties may possibly diminish the hyperplasia in the bronchial walls. In gouty cases it is of particular benefit.

Naphthalin acts as an energetic expectorant and stimulant. Best prescribed in pastilles, each containing 1½ to 8 grains, 1 to be taken three times daily. It should be carefully used, lest it show irritant effects on the kidney. Wyss (Ther. Gaz., May 15, '88).

Tar in tabloids, containing the whole of the constituents of the drug, is palatable and speedily disintegrates. Murrell (Med. Press and Circular, Nov., '92).

Literature of '96 and '97.

Hydrastis used in a great number of cases of bronchitis and found that in the initial stage of acute bronchial catarrh it was quite ineffectual; the disease became protracted and the sputum assumed a muco-purulent aspect. It was particularly efficacious in chronic bronchitis, mitigated the cough strikingly, facilitated expectoration, changed the muco-purulent sputum to a mucous one, and decidedly diminished the physical signs.

Hydrastis, if not quite so prompt as opium in checking cough, is more enduring and its final effect is greater. It is the equal of any expectorant and solvent in use. To adults he gives 20, 25, or 30 drops of the fluid extract, four times a day, in a little sweetened water; in case it does not produce the expected effects, increase the dose. Hydrastinine is not so trustworthy as the fluid extract. Saenger (Centralb. f. inn. Med., May 1, '97).

The balsams and various expectorant oils are of much value used by inhalation and internally. By inhalation they act directly upon the mucous membrane, while when given internally they exert their influence locally upon their excretion through the respiratory organs. The most useful are the compound tincture of benzoin and the oils of eucalyptus, gaultheria, sandal-wood, cubebs, and copaiba. For inhalation these drugs may be used on the Yeo respirator, in a croup-kettle, or in a nebulizer. Creasote is of value where the stomach will tolerate it.

Number of cases in which success was attained with the essence of pinus pumilio put up in transparent gelatin capsules the size of a small pea. Lantier (Gaz. Méd. de l'Algérie, June 15, '89).

A mixture of equal parts of turpentine and olive-oil, rubbed twice a day, on the front and back of the thorax, and down the arms as far as the elbows. The patients are then covered with a light flannel, and the usual dress put on over

this. Paris Correspondent (Archives of Pediatrics, Dec., '91).

Terpine, in doses of 3 to 15 grains, three or more times daily, recommended. Lépine (Ther. Gaz., May 15, '88).

Terpine may be given with impunity to the amount of 7½ to 75 grains in cases of acute or chronic bronchitis, with no trouble occurring on the part of the digestive or urinary tracts or the nervous system. Bufalini and Martini (L'Union Méd., July 13, '88).

In milder forms satisfactory results obtained by the use of a pill of terpine hydrate and salol, 3 grains of each, given from four to six times daily. S. Solis-Cohen (Annual, '89).

Terpine used as an elixir, with cherry-laurel water as an aromatic, 5 grains to the half-ounce, not only relieves cough, but acts at the same time as a diuretic and antineuralgic. W. Murrell (Brit. Med. Jour., Mar. 4, '93).

Menthol, used by inhalation, an excellent expectorant, allaying the violent attacks of cough, which exhaust the patient's strength. Wyss (London Med. Rec., Mar. 20, '88).

Topical treatment by direct inhalations from No. 65 Davidson atomizer, connected with an air-tank of about thirty pounds' pressure. The tip introduced into the mouth and the patient is instructed to make as prolonged an aspiration as possible, to inhale gently and repeatedly, drawing it into his lungs. Formulæ found most useful: menthol, 1 to 2 per cent.; creasote, 1 per cent.; camphor, ½ to 1 per cent.; eucalyptus, 2 per cent.; pine-needles, 2 per cent.; in albolene or benzoinal. Average quantity to be inhaled is 2 drachms, after which the patients begin to gag. Kuh (Chicago Med. Recorder, Mar., '93).

Iodide of ethyl in 10-minim doses, sprinkled on a handkerchief and inhaled, very beneficial in cases complicated with Bright's disease and fatty heart, with feeble circulation. Especially useful when the bronchial secretion is viscid and there are urgent symptoms of dyspnœa. About five minutes after the inhalation the patient coughs and expectorates, which relieves the distressing symptoms. Main (Med. Record, Jan. 11, '89).

Literature of '96 and '97.

The treatment of bronchitis divides itself into modification of the function of the bronchial mucous membrane so as to alter the secretion, and also with the object of combating congestion to facilitate expectoration, to calm the cough, and to improve the general health. The chief agents which, after absorption, are eliminated by the respiratory passages, consist in greater part of balsams, of plants containing essential oils, sulphur and its compounds, and the iodides. Of the first class in particular are tar, balsam of Tolu, benzoin, turpentine and terpine, eucalyptol, and creasote. The inconvenience attending all is that they exercise an irritant influence upon the stomach. Copaiba, though rarely employed, nevertheless is very efficacious.

Turpentine is usually employed in capsules holding 3 or 4 minims, but terpine has quite largely taken its place. Creasote aids in getting rid of the secretion, and acts deleteriously upon tubercle bacilli. The balsams are usually employed by inhalation.

Eucalyptol may be prescribed in capsules containing 1 grain and given three or four times a day; it is preferable to turpentine as it is not so apt to produce disturbance of stomach and kidneys. Lyon (Revue de Thér. Medico-Chir.; Ther. Gaz., May 15, '97).

Respiratory gymnastics, by increasing pulmonary capacity and accelerating the pulmonary blood- and lymph- circulation, are efficient. External applications to the chest-wall are of doubtful value in the absence of acute exacerbations and of pulmonary or pleural involvement.

Systematic daily practice of full, deep inhalations of pure atmospheric air, and the judicious exercise of the deep muscles of the chest, of great advantage. Cassell (Amer. Pract. and News, Feb. 13, '92).

The diet should be nourishing and should be strictly regulated to the condition of the digestive organs. Excess of starches is to be avoided because of their tendency to cause flatulence and con-

sequent mechanical interference with respiration. In cases associated with gout the question of diet is one of extreme importance.

Fœtid Bronchitis.

This form is only differentiated from others by the odor of the sputum. In many cases this is due to retention of the secretion in bronchiectatic cavities. (See BRONCHIECTASIS.)

Symptoms.—Fœtid bronchitis begins as an ordinary bronchitis, which later assumes the purulent form; or it may be ingrafted upon a chronic pneumonia, a bronchiectasis, or even a suppurative pleuritis that has perforated into the lung. The early symptoms are those of simple bronchitis. The pulse is rapid and there is continuous fever, but the temperature-record is usually irregular. The change to purulent inflammation may be marked by a chill or a succession of chills. Respiration is accelerated, and the severe cough causes the abundant expectoration of an alkaline, semi-liquid, putrid sputum, which sometimes amounts to seven or eight hundred cubic centimetres per day. This sputum possesses an odor said to be quite characteristic of the disease, and resembling somewhat that of acacia-blossoms. The disease may terminate favorably, or it may cause death by the development of pneumonia, bronchiectasis, abscess, or gangrene. There seems to be no specific sign or symptom of the affection, unless it be the peculiar odor of the sputum, which Lumniczer claims is developed by the growth of the bacilli that cause the disease. (Whittaker.)

Death is generally due to exhaustion or through some intercurrent disorder kindred to the major affection.

Ulceration, ampullar dilatation of the bronchi, pneumonia, pleurisy, gangrene, and metastatic purulent deposits in other regions are the main complications of this stage of bronchitis. Abscess of the brain may thus become the cause of death.

> Case of abscess of the brain as a result of putrid bronchitis, followed by paralysis. The patient died in deep coma. Kohler (Deut. med. Woch., Feb. 19, '91).

Etiology and Pathology.—It is probable that in all cases retention of the secretion, with bacterial activity, is the cause of the fœtor. Leyden and Jaffé found small rod forms, to which they gave the name "leptothrix pulmonalis." They also noticed in the putrid sputum numbers of spirilla and infusoria. Lumniczer describes a short, somewhat curved bacillus, which he found in great numbers in the plugs of pus and *detritus* expectorated, which give the sputum its characteristic foul odor. More recently Hitzig isolated two species of bacillus, the one presenting the characteristics of the coli bacillus—short, thick rods—did not liquefy in gelatin; was found pathogenic for guinea-pigs and rabbits. The second did not liquefy in gelatin and was pathogenic for mice and guinea-pigs. This question may still be said to be *sub judice.*

Besides the causative factors acting in the case of chronic bronchitis, repeated exposure to dust, especially that originating from dyed woolens or cotton fabrics, is prone to lead to the fœtid form: a mere complication of those already described.

> Case in which the etiological factor seemed to be some irritating and septic material inhaled from furs, felt mats, etc., in which the patient was accustomed to wrap himself when traveling in Siberia. Levashoff (London Lancet, June 9, '88).

Treatment.—The agents recommended in chronic bronchitis are also valuable here, especially the balsams, terpine, turpentine, or terebene. Five to 10 min-

ims of the latter in capsules, taken after meals, are very effective in most cases. The preparations of tar, already mentioned, are also valuable. In cases in which the fœtid expectoration only occurs at intervals, sandal yields gratifying results. Narcotics should be avoided. Hyposulphite of soda has been highly extolled; it promptly changes the character of the expectorated material and thus eliminates the fœtor.

Sodium hyposulphite recommended in fœtid bronchitis, daily doses of 60 grains being given; larger doses cause diarrhœa. It is also useful in bronchial dilatation and pulmonary gangrene. But one remedy which will calm the cough of herpetic subjects: sulphate of quinine in doses of 23 ¼ to 31 grains for adults and 6 to 12 grains for children, taken in two or three doses half an hour apart. Patients must feel buzzing in the ears, vertigo, etc. Lancereaux (Jour. des Practiciens, No. 27, '95).

Literature of '96 and '97.

Hyposulphite of soda employed in a large number of cases for the purpose of combating the fœtid character of the expectoration and modifying the septic condition of the bronchial tube. It may be taken each day in doses of from 2 to 3 drachms without difficulty; it is eliminated partly by the urine and partly by the lungs. Half an ounce acts as a laxative and half as much more as a purge. It is contra-indicated where there is a tendency to hæmoptysis. Dumas (Revue de Thérapeutique, Mar. 15, '97).

Intratracheal injections have been recommended, the agents used—menthol, camphor, etc.—being dissolved in oil or albolene. A Pravaz syringe with a long curved tip, which may readily be introduced into the larynx, is used. Fifteen to 30 minims are well borne, and if properly applied excite comparatively no cough. Nitrate-of-silver solutions of varying strengths have also been employed, but one exceeding 10 grains to the ounce is apt to excite laryngeal spasm. Still, much stronger solutions have been employed with impunity.

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Good results obtained in the treatment of putrid bronchitis by the injection of a 5-per-cent. solution of nitrate of silver into the trachea. Fifteen to 30 minims of this solution may be injected each day without provoking an excessive cough. There is a diminution in the quantity of the sputum, disappearance of its fœtid odor, and an amelioration of the bronchial symptoms. Rosenfeld (L'Abeille Méd., Nov. 28, '96).

Fibrinous, or Plastic, Bronchitis.

In this variety the secretion from the mucous membrane tends to form coherent casts of the bronchial tree.

Symptoms. — Fibrinous, or plastic, bronchitis is characterized by the occurrence of paroxysms of cough and dyspnœa, which immediately cease on the expectoration of the casts. The paroxysms are usually preceded and followed by a sort of catarrh. Hæmoptysis may be absent or it may be very serious. It usually ceases at once with the ejection of the casts. As a general thing, but little pain is present, except that caused by coughing. In acute cases the temperature may rise to 104° F.; in chronic cases it is seldom above normal. Sometimes the onset of an attack is marked by one or more rigors: suggestive of pneumonia. As a rule, each attack consists of a number of short paroxysms. It may subside after a few days never to recur again, or may last continuously for ten, fifteen, or twenty years. (West.)

Auscultation and percussion reveal signs similar to those witnessed in chronic catarrhal bronchitis, but they occupy a limited area like those of obstructed bronchioles; from time to time,

intense paroxysmal cough occurs, accompanied with dyspnœa and cyanosis, ending in the expectoration of the pathognomonic sputa.

Etiology. — Although syphilis and tuberculosis have been considered as etiological factors, it is probable that these diathetic affections were probably, in the cases reported, but concomitant disorders—manifestations originating in local and general depravity. Indeed, in many cases no diathesis, inherited or acquired, could be discerned. There seems, however, to be a familial tendency to the affection, several members of individual family having suffered from it as a result of bronchial catarrh. This sufficiently indicates how obscure is our knowledge of the causes of this affection.

Pathology.—The casts may be found rolled up in the form of balls in the sputum. On mixing the sputum with water the casts are unrolled and may be spread out with needles. In some cases they are associated with Curschmann's spirals and Charcot-Leyden crystals. Bronchial casts are occasionally seen in croupous pneumonia, in diphtheria, and in hæmoptysis, but these casts are to be explained otherwise than as examples of fibrinous bronchitis. Eppinger has observed that in croupous exudation there seems to be a central condensed mass of exudate, which serves as a nucleus upon which are deposited successive layers of translucent fibrin. The mucous membrane is not infiltrated, as it is in a croupous exudation. Eppinger advanced the idea that on account of a chronic congestive catarrh of the bronchi the permeability of the walls of the vessels of the submucous connective tissue is increased and allows the fibrinogenous substance of the blood to escape. This transudation, moreover, is favored by the attenuated epithelial covering of the tubes: a condition that is the direct result of the catarrhal inflammation present in nearly all these cases. The exact cause of this cast-formation has not been definitely determined. That the casts are composed of mucus, and not of fibrin, has been definitely proved by Graudy.

Case in which the casts were expelled in great numbers. The majority measured from 3 to 4 inches, some as much as 6 inches. They had evidently been deposited in successive layers, and consisted of concentric laminæ, which can be separated when dry. They consist of coagulated albumin soluble in alkalies. Showed fibrillar material, in the meshes of which were numerous leucocytes and fat-globules, some hæmocytes, and epithelial cells. Octahedral crystals, said to be similar to those found in bronchitic asthma, have been observed by others, but the spirals seen by Curschmann were not found. Stirling (London Prac., June, '89).

Special nature of the fibrinous blocks, viz.: syntonin enters into their composition. Histology revealed a structure analogous to the coagulations of aneurisms. Caussade (Bull. de la Soc. Anat., May 10, '89).

Case of acute fibrinous bronchitis in which the patient awakened suddenly at night with feeling of great oppression in the chest. Severe coughing followed, and a large white mass was coughed up, whereupon the discomfort disappeared and the patient slept again. This occurred three times. Proved to be casts of bronchial tubes. After six weeks the patient died. Section showed thickening of the mitral and tricuspid valves, hyperæmia of the bronchial tubes, a large infarction in the right lung, and tubercular disease of the left kidney, ureter, and bladder. Rohr (Corres. f. Schweizer Aerzte, Dec. 15, '92).

Post-mortem examination of a case of primary membranous bronchitis showing miliary tuberculosis in pia mater, lungs, peritoneum, spleen, intestines, etc. Bacil-

lus of Friedländer. Magniaux (Thèse de Paris, '95).

Plastic bronchitis occurs frequently after pneumonia. In some cases is associated with grave skin affections. There seemed in one case, also, to be a relation between the formation-casts and the catamenia. West (London Pract., Aug., '89).

Inflamed mucous membrane of trachea and largest bronchi in certain cases observed. Post-mortem longitudinal bands or ridges often found. These ledges formed chiefly of granulation-like tissue, and quite large nerves have been detected traversing this tissue. A. G. Auld (Lancet, Dec. 28, '95).

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Acute fibrinous bronchitis presents the type of a pure infection, and is possibly due essentially to staphylococci (albus and aureus). Typical acute cases are rare, the milder forms being more frequent, and the latter are probably often overlooked or mistaken for asthma.

Chronic fibrinous bronchitis is an obscure process, with a different etiology, but included with the acute disease on account of the occurrence of the casts. The latter, however, may occur in other chronic diseases (tuberculosis, heart disease).

Pulmonary tuberculosis appears to play only a subordinate rôle in the etiology of chronic fibrinous bronchitis. Sokolowski (Deut. Archiv f. klin. Med., B. 56, p. 476, '96).

Case in which the autopsy showed that the pseudomembranes extended from the posterior nasal outlets clear down to the third divisions of the bronchi. The only bacteriological element found was the staphylococcus. J. Glover (Anna. des Mal. de l'Oreille, du Larynx, etc., No. 5, '96).

Case in which the patient had suffered from the disease for some years, and was constantly expectorating bronchial casts. All the cover-slips from the casts showed streptococci; the inner surface showed micro-organisms of varying kinds, probably coming from the saliva. The disease due to the streptococcus; Marmorek's antistreptococcic serum used. After two months' treatment the patient was discharged much improved. The reaction to the antistreptococcic serum a further proof of the nature of the disease. Claisse (Comptes-Rendus de la Soc. de Biol., Apr. 3, '96).

Histological appearances in the bronchi of a patient suffering from this disease who died of cardiac failure. Neelsen had found them to consist of mucus: a view which had hitherto met with no support. In this case the casts were found to consist apparently of fibres inclosing masses of leucocytes and large, swelled, round epithelial cells. Weigert's fibrin stain gave no coloration, thionin a faint pink; Curschmann's spirals were absent, this being the sole point of difference from Neelsen's results. The casts were thus composed of mucus and not of fibrin. With regard to the bronchi, the epithelium was intact except in a few spots; Weigert pointed out many years ago that fibrinous exudates only arose where the epithelium had been shed over large areas. In the case under notice the goblet-cells were unusually numerous, and the glands had undergone mucoid degeneration, their ducts being filled with mucus. The origin of the casts was thus obvious. Graudy (Centralb. f. allgem. Path., vol. viii, No. 13, '97).

Examination of two cases secondary to valvular disease. Stained by Weigert's method, they showed very fine fibrin-fibres, most of the casts not taking any stain (lithium carmine). Chemical examination also showed the absence of fibrin, but proved that the casts were made up chiefly of mucin. The casts were of acid reaction, and the writer thinks this is the cause of the coagulation. According to his view something, probably the action of bacteria, causes the bronchial secretions to become acid. The mucus then coagulates. The same explanation appeared to the casts sometimes expectorated in croupous pneumonia, and was able to confirm his view in a case of the latter disease. A. Habel (Centralb. f. inn. Med., No. 1, '98).

Treatment.—The treatment does not differ from that of other forms of bron-

chitis except the fact that alkalies (potassium iodide and carbonate) and alkaline steam-sprays are of more decided value. The iodide of potassium acts by stimulating secretion and thus assisting in the elimination of the pseudomembrane. It must, however, be given in large doses.

Inhalations of alkalies recommended. Especially valuable are aqua calcis, alone or with equal parts of water, or with 2 to 5 per cent. of carbonate or bicarbonate of sodium, in which the casts are soluble. Stirling (London Pract., June, '89).

Case in which 45 grains in divided dose was administered daily to induce mucoid exudation in the bronchi and facilitate the ejection of the casts, which, in the present case, were found to consist mainly of mucin containing staphylococci and a special bacillus. The patient was permanently cured. Huchard (Semaine Méd., July 28, '95).

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Potassium iodide is probably the most useful remedy in all forms of the disease, as it increases the bronchial secretion when given during the acute paroxysm, and thus aids in expelling the casts. It also seems to lessen the tendency to recurrence of attacks if given in full doses and for a long period of time. J. W. Brannan (Med. News, Aug. 15, '96).

FREDERICK A. PACKARD,
Philadelphia.

BRONCHOCELE. See GOITRE.

BRONCHO-PNEUMONIA. See PNEUMONIA.

BRONCHORRHŒA. See BRONCHITIS.

BROWN-SÉQUARD'S PARALYSIS. See PARALYSIS.

BUBO. See GONORRHŒA and SYPHILIS.

BUBONIC PLAGUE. See PLAGUE.

BUCKTHORN (CASCARA).—The bark of the European buckthorn (*Rhamnus frangula*) and that of the Californian variety (*R. purshiana*), in spite of the interested claims of manufacturers, are practically identical in medicinal effect; if there is any superiority, it lies with *R. frangula*. Both require that the bark should be carefully gathered, dried, and allowed to lie for at least two years in order to get rid of a principle therein that is likely to induce griping.

The active (neutral) principle—"cascara sagrada," the source of the Californian bark—is supposed to be a glucoside, termed "cascarin," but this baptism is entirely superfluous, since it is identical with the principle found in the European bark, known as frangulin and xanthin.

Physiological Action. — Buckthorn and cascara are laxative, slightly tonic, and stomachic. If both are prepared and administered in the same way, the results will be found to be identical.

Preparations and Doses. — Abstract buckthorn (or cascara), 2 to 15 grains.

Extract buckthorn (or cascara), 1 to 8 grains.

Extract buckthorn (or cascara), tasteless, 1 to 8 grains.

Fluid extract buckthorn (or cascara), 3 to 45 minims.

Fluid extract buckthorn (or cascara), aromatic, 3 to 45 minims.

Cascara cordial, 1 to 4 drachms.

Elixir buckthorn, $^1/_2$ to 2 drachms.

Cascarin (or frangulin), concentration, 1 to 8 grains.

Therapeutics.—These preparations, to secure their best laxative effects, should be given half an hour after meals, and increased or diminished in dose, or repeated at lesser intervals, according to

the action desired. In habitual constipation the best results are obtained by giving small doses at frequent intervals, thereby securing a continuous impression on the digestive tract.

BUHL'S DISEASE. See NEWBORN.

BULBAR PARALYSIS. See PARALYSIS.

BUNION. See FOOT, DEFORMITIES OF.

BURNS.

Definition.—A burn is a high grade of acute inflammation, following the direct or indirect application of dry or moist heat to a portion of the cutaneous or mucous surfaces.

Varieties. — For ease of comprehension burns have been separated into grades according to their severity. The character of inflammation observed in these grades is governed by the exciting agent, its capacity for the absorption of heat, the duration of its contact, and the susceptibility of the part acted upon. Solid substances (copper and iron) and the fixed oils (olive and linseed) cause a greater impression than volatile (alcohol, ether, and chloroform) or aqueous (water and vapors) materials. Certain articles, owing to their tenacity (copper), although absorbing the same amount of heat as others (iron), cause more decided destruction.

The length of contact, giving in the shorter periods a superficial incineration and in the longer a deeper destruction, is of importance in determining the grade of inflammation. The more dense and thick portions of the skin (buttocks, palms, and soles) offer greater resistance than those of thinner (face, neck, and abdomen) texture.

The effect upon the system will depend upon the character of person attacked, those of stronger constitutions being the more able to controvert shock than those of weaker frame.

A temperature, slightly increased above the normal (as, for instance, 100° F.), produces only a slight hyperæmia (first degree: dermatitis ambustionis erythematosa), which may disappear shortly after breaking the contact, while a rise to 150° F. will cause some appearance of vesicles and bulla (second degree: dermatitis ambustionis vesiculosa et bullosa) and destruction of the epidermis, the effect of which is not relieved for days after the removal of the burning substance, and yet, on the other hand, heat at the boiling-point of water (212° F.) may cause a complete carbonization of the part, resulting in the formation of eschars varying in color from a yellow up to a dark brown or black or, in other words, the production of gangrene (third degree: dermatitis ambustionis escharotica seu gangrenosa).

Symptoms. — The effects of a burn upon the body-structure are both local and constitutional. The former often results in great disfiguration or destruction of tissue, while the latter depresses the vital forces or terminates in death.

LOCAL EFFECTS. — In burns of the *first degree* the appearances produced are superficial. There will be observed a distinct hyperæmia with redness of varying intensity from the slightest blush up to a pinkish red or brownish red. This may or may not be entirely effaced by pressure. Persons of fair complexion or thin, delicate skin are affected more greatly by the same amount of heat than will be those of darker hue or more dense integument. Swelling is present to a slight degree and does not extend far beyond the limits actually exposed to

the burning substance. This type of burn is produced by indirect contact with the flame of a lighted match, proximity to a heated metal, escaping steam, and the actinic rays of the sun.

With or without treatment the effect of burning to this extent may disappear shortly after removing the exciting cause. Resolution takes place in this variety by the disappearance of the swelling, the serous infiltration being absorbed, the color diminishing to the normal except in those cases in which a slight degree of pigmentation is left in the form of ordinary increase, which usually disappears as time progresses or where the sun's rays cause perhaps a permanent stain such as lentiginous patches. The linear fissures of the skin appear prominent because of the semidetachment of the membrane between them, which, as time passes, the new skin forming beneath compels their complete detachment in the form of minute flakes of deadened epithelium.

In burns of the *second degree* the inflammation, while yet superficial, may still occupy the entire epidermis. In some cases the upper layers alone of the cuticle may be destroyed, while vesicles or bulla may be observed over the affected surface. In still other cases the corium is stripped entirely of its epidermal covering or particles of the membrane may be rolled into whitish masses over its exposed surface. These vesicles or bulla may be produced directly by the contact of the heated article or indirectly by the consequent inflammation. They may retain their contents or, owing to the increased flow of serum, their walls, becoming thin and losing their elasticity, rupture, thus allowing the escape of a continual discharge over the denuded surface. The true skin, which is exposed either entirely or at points, shows a highly-reddened surface, over which this continual exudation may be observed. The papillary vessels are seen to be deeply congested, or, if ruptured, their flow of blood intermingles with the discharge of serum and gives it a tint of red. Swelling is present in both of these conditions, but is governed by the extent of surface and the density of the part involved. In this type of condition actual contact with the heated substance takes place either in shorter or longer durations. Such articles as heated iron, transient or lengthened action of flames, and boiling liquids may be the exciting agent. The effects of this form of burn do not always show to what extent they have progressed immediately upon the removal of the cause, because of the systemic conditions which may be induced. Pain is always present to a minor or major degree.

Resolution takes place through coagulation of the serous discharge, which occupies the involved area as a fibro-albuminous covering, beneath which the new skin is allowed to form. After the new integument has progressed almost to its normal aspect this covering, which by this time has become a darkish crust, becomes loosened and falls off, exposing a thin, delicate skin, through which the more vascular structures immediately beneath are observed. It is not for weeks, months, or even years that the normal pinkish-red tint of the skin is restored. Burns of this character usually leave a fairly-normal aspect to the surface and rarely cause the formation of cicatrices. If a cicatrix is formed, it is generally superficial and flattened, resembling, to a marked degree, the flat, sebaceous warts observed in the aged.

In the burns of the *third degree* the inflammation or destruction may be superficial, extending over considerable

area, or deep, affecting the subcutaneous tissues, muscles, and even bones. In those of the superficial variety the extent of surface-involvement may be variable, in one instance occupying a portion comparing with the size of the hand, and in others being observed upon portions ranging from six or seven inches to areas as large as one limb or even one-third or one-half of the body-surface. In this variety the epidermis alone may be destroyed and expose the corium to view, covered with particles of charred cuticle, or the corium itself may share in the destruction, being deposited over the affected areas in strips of dried eschars. The parts uncovered by these destructive influences present, either the corium or subcutaneous tissue, a highly-vascular aspect, from which there is a continuous exudation of serum intermingled with the escaping blood. The dead tissues vary in proportion according to extent of heat, its length of contact, the thinness or density of the part involved, and the amount of surface encompassed. They may be thin or thick, large or small, and retain their hold for longer or shorter periods.

Resolution takes place in the uncovered variety in the same manner as described under the foregoing degree, while in the covered variety granulations spring up beneath the charred remains which, after a time, desiccate and fall off, exposing a similar surface to that of the second degree.

In the deeper form of burn the extent of surface involved may be small or large, but may dip down to varying depths. It may be limited to the destruction of the skin (epidermis and corium) and the subcutaneous tissues, or it may expose the muscles, attack the nerves and blood-vessels (allowing hæmorrhage), and even the bone. The amount of charring will usually be very great and will lay about in masses over the burned surface, thus preventing a view of the destruction beneath. In some cases the degree of loss will be so enormous that the bone will be entirely stripped of all covering. Hæmorrhages will often be encountered and may result fatally. Fractures of bone will occasionally complicate matters. This variety will show both the first and second degrees at areas remote from the greatest destruction. Resolution even in the milder cases is slow, and before such happens surgical interference may be demanded. The same appearances may be noted throughout its process as found in the superficial variety, but to a different degree. The causes which bring about this form of burning are usually dry heat (flames or contact with electric wires), and it generally causes much greater destruction than will moist heat. The effect upon the system is generally of an alarming character, and shock may carry off the person before relief can even be attempted.

Electric and X-ray Burns. — Burns from electricity may be observed in all the varieties mentioned above. They may follow direct or indirect contact. Examples of direct contact are observed after handling live (charged) wires, and may be found to destroy all parts with which it comes into touch, or life even may be the forfeit.

Literature of '96-'97-'98.

Case of severe electrical burn in an electrician employed in the electric plant used to furnish power to the city street-car line and to the arc and incandescent lights of the city. The patient had accidentally brought his back in contact with the positive and negative keys of the switchboard of arc-line furnishing 96 street-lamps and carrying 4000 volts of electricity. He was released by the

tissues being burned away in two pits about three inches in diameter and down to the bony structures. The intervening space between these pits, which were ten inches apart, was roasted, and after the lapse of a few weeks was lifted out. It weighed two pounds and a half. The sloughing was such that the cotton, bandages, clothing, and bed were saturated with pus. Recovery. J. F. Weathers (N. Y. Med. Jour., Apr. 2, '98).

A most recent form of burning of the skin from the indirect contact of electricity is by the x-ray apparatus. Close proximity to the ray by either covered or uncovered parts result either in a superficial or deep inflammation of the skin. It may be observed a few hours after exposure to the rays or may be delayed for several weeks. Gilchrist, of Baltimore, in a case did not see any effect for several (three) weeks after exposure, while Crocker, of London, observed a case in which the effects were produced in one day thereafter. This form of burning attacks the skin alone in some instances, while in others the deeper structures, as the muscles, tendons, nerves, and bones (periostitis and ostitis resulting) are involved. The effects may remain for days, weeks, or even months after the application. X-ray burns are supposed by some to be produced by the action of the ray or by particles of aluminium or platinum reaching and being deposited in the tissues by others.

Burns of Mucous Surfaces.—The mucous surfaces may be affected by the inhalation of flames, vapors (volatile or boiling acids), boiling liquids (water, slacked lime), and by certain substances acting directly, such as ammonia and sulphuric and hydrochloric acids. The mouth, pharynx, larynx, bronchi, and the œsophagus, as well as the stomach, share in the attack. The eye often, from its exposed position, is the seat of burn. Conjunctivitis often results from irritants coming into direct contact with the eye, and if the exciting agent is not soon removed great destruction of substance or sight may be the result.

Constitutional Effects.—The effects of burns of the first degree upon the system are generally slight and are limited to pain, which disappears shortly after the removal of the exciting agent, but often may last for several hours.

In burns of the second degree the pain accompanies the phenomena not alone for hours and days, but often for weeks and even months. The shock may be of a transient character or of an alarming intensity. It may be encountered at the time of accident or be delayed for periods varying from hours to days thereafter. When small areas are involved, the depression may soon be relieved, but when one-fourth or one-third of the body is attacked death may intervene.

Burns of the third degree may be so severe that death intervenes before pain has time to appear. Shock at this stage is therefore observed early and of the worst character. Early mortality is generally due to the shock, while late mortality usually occurs during the stage of suppuration. Vomiting is often observed in both the second and third degrees.

Children suffer more from burns than do adults, and women more severely than men. The temperature is not affected by burns of the first degree, but is a marked symptom in those of the second and third. At the time of accident it may decrease from one to three degrees below the normal (to 97° or even 95°) and remain at that point until reaction begins, which is in about 36 or 48 hours, when it rises during the next 12 to 18 hours to 104° or 106° or more, at which point it remains for a period

of 8 to 10 days (possibly rising and lowering at irregular intervals), when granulations, now in a fair formation, act as a retarding agent.

Complications.—The after-effects of burns may be concentrated upon the viscera (neural, thoracic, and ventral cavities) or directly upon the part affected (cicatrices, contractions, and fractures of bone). Burns of the first degree remain uncomplicated, while those of the second and third present many variations. The meninges (arachnitis following burns of the head), as well as the brain proper, may become congested or even highly inflamed, the sufferer presenting all the symptoms of restlessness and delirium, ending either in convulsions or coma. Tetanus is an early complication observed. Bronchitis and pneumonia often result either from inhalations or indirectly from surface burns. Congestion in the kidney has been noted, with resulting albuminuria or hæmoglobinuria, while in many cases the urine becomes exceedingly scanty. Autopsies have shown rupture of the diaphragm and stomach, accompanied by contraction of the bladder. Amyloid degeneration in the viscera has been noted after prolonged suppuration. Inflammation of the gastro-intestinal tract with the formation of an ulcer (usually one, but more rarely several) of the duodenum (at its pyloric end) frequently occurs. This ulceration may begin early (four or five days) or it may be delayed for weeks, although, without the appearance of rectal hæmorrhage or perforation, with consequent peritonitis, we have no means of determining its presence. At times this inflammation extends to the colon and causes diarrhœa. Burns affecting either the chest or abdomen are the inducing cause, although severe burns at other points may produce them. Septicæmia, pyæmia, or erysipelas (the streptococci being found after death in the blood) may be the fatal ending.

Literature of '96 and '97.

Investigations concerning the cause of death after burns. Conclude that the deaths are caused by toxic ptomaines. The ptomaines of burnt organs are the same when the organ is first removed from the body and burnt. Healthy animals inoculated with this die with the same symptoms as burnt animals. Death after burning is therefore due to the absorption of ptomaines produced by chemical changes in the tissues due to burns. The immediate removal of the burnt part prevents this absorption, and consequently all specific symptoms of the burn and death. The same objects may be attained by venesection and the immediate transfusion of healthy blood or artificial serum. Anjello and Parascandola (Gazz. degli Ospedali e delle Clin., No. 83, '96).

Autopsies on the bodies of five small children who had died of severe burns: The most noticeable gross lesions were cloudy swelling of the liver and kidney, acute swelling of the spleen, and swelling and congestion of the lymphatic glands and other lymphatic tissue. Microscopically the most interesting lesions noted were parenchymatous degeneration of the kidneys and liver, focal areas of necrosis in the liver, and pronounced focal necrosis in the lymphatic tissue. The lymphatic tissue was affected throughout the body. The Malpighian corpuscles of the spleen, the tonsils, the gastric lymphatic follicles, the enteric, solitary, and agminated follicles, and the lymphatic glands, all showed essentially the same changes. The lymphatic glands were much swelled and at times congested. The earliest changes were in the follicles, and consisted of an œdematous swelling. This was more marked toward the centre of the follicle. In areas of less advanced alteration the lymphocytes were merely less closely packed together than is usual, but in the areas of more marked change the lymphocytes were swelled and their nuclei fragmented.

The focal degeneration in the lymphatic follicles of the tonsil and of the stomach and in the Malpighian bodies of the spleen is essentially similar to that of the follicles of the lymphatic glands. In these areas of degeneration in the lymphatic tissue we find appearances essentially similar to those seen after the injection into the body of various bacterial and other toxalbuminous substances. The lymphatic glands from the cases of skin-burn might readily be mistaken for the lymphatic glands of children dead of diphtheria. The lesions in the other organs are also essentially similar to those found in the bodies of persons dead from acute infectious diseases. One of the main causes of death after burns, therefore, is in a toxæmia caused by alterations in the blood and tissues, the direct effect of the elevations of temperature. Bardeen (Johns Hopkins Hosp. Bull., Apr., '97).

Legal aspects of burns. In cases where the persons have been alive when they were exposed to the fire, soot is found in the ramifications of the trachea and bronchi. If the red blood-corpuscles are found disintegrated and disfigured throughout, then this is a further sign of a person having been burnt while alive; the blood of animals which have been burnt or scalded after death shows only occasionally a few broken-up, crenated, or polymorphous red corpuscles; as a rule, the red blood-corpuscles retain their shape and integrity, and appear only swelled and paler. Robert Neupert (Friedreich's Bl. f. ger. med. u. Sanitætspol, vol. xlviii, pt. 3, '97).

The attempt of nature to restore a covering for these denuded tissues often results unwisely. Vicious scars, adhesions of contiguous parts (causing webbed fingers, the arm being attached to the side by granulations), and deformities may be encountered. Cicatrices may be small and flat or large and rugous. The skin may be as soft and pliable as in the normal state, or tightly stretched and drawing the parts from their anatomical position. Calcareous degeneration or even epithelioma may attack the scars. Pressure upon the terminals of the nerves may either cause neuralgia or spasm of the glottis, which may demand surgical interference for its removal. Finally, keloidal tumors may be observed as a consequence of vicious scarring. They will not differ from those produced by other abnormalities and will accept all the gyrations encountered in other conditions. All of the scar may not be affected with keloid, as, for instance, one end may show the prolongations, while the other resembles ordinary cicatrices. The contractions of the skin after scarring may produce great deformity and the hand may be drawn backward upon the arm or talipes calcaneous may result or other disfigurations too numerous to mention may be shown. Exposure of joints have taken place followed by ankylosis. Bones have been fractured from loss of substance (cooking of the muscles).

Diagnosis.—Ordinarily the recognition of burns is not a difficult task, although the differentiation of the varieties, especially of the second and third degrees, may demand careful examination. Burning flesh with destruction of its particles, exposure of the underlying tissues (muscles, bones, etc.), will be a train of symptoms not to be controverted. The difference between burns and scalds often may occasion difficulty, but the fact of the greater and deeper destruction of the former with the more superficial character of the latter will generally be sufficient. The loss of hair follows the former because of this deep destruction of the hair-follicle and papilla.

Pathology.—The condition immediately following a burn is that of diminished blood-supply to the part attacked. This seems in part to be due to the de-

creased size of the vessels, probably following a spasm of the vasomotor system. As the blood is prevented entrance into the smaller blood-vessels there is a consequent engorgement of the viscera, with actual congestion or even inflammation of their mucous linings. The process does not end here, but we note a change in the corpuscular elements of the blood itself; the lumina of the blood-vessels are decreased, which allows the formation of thrombi with more or less complete general stasis and possibly resulting in a cardiac paralysis. This overstimulation of the mucosæ may account for the degenerate changes which have been observed in the abdominal viscera, ending, as stated, in the formation of ulcerations of the duodenum or which have caused the extension of the inflammation to the colon and terminate in the production of diarrhœa and hæmorrhage. Thus the mode of death is apparently due in some cases to the formation of pulmonary thrombi which occasion this paralysis of the heart. Other cases probably end in narcotic poisoning from absorption of the dead epithelium or from the burned clothing or other adhered materials.

Prognosis.—The termination of this class of injuries is often of serious import especially when medico-legal questions arise. This should be determined by the several factors which arise in each case. Consideration must be given to individuality of the sufferer, both his age and constitutional acquirements; the extent of the burn, both as to surface and depth involved; the location of the injury, and the nature of the exciting medium. The effects upon strong, robust subjects are not so marked as upon those of weaker constitutions, and, while the same degree or extent of burn will soon be recovered from by the former, the most dire results may follow in the latter persons. Thus it may be noticed that burns among machinists, glass-blowers, plumbers, and foundrymen will not be so serious as would the same degree or extent among clerks or those engaged in gentlemanly pursuits. Colored persons suffer less severely than do the white. Females, on account of more delicate systems, are less able to resist shock than are the males. Middle life is not so severely affected as are children or aged people. Some persons may be able to resist the shock only to be carried off by the complications that arise.

Surface involvement seems to exert a greater depression or fatality than does depth of tissue. A burn, even of the first degree, which occupies an extended area and those of the second may terminate fatally if one-fourth or one-third of the superficial parts are involved; a fatal issue may also occur in burns occupying one-half of the body-surface. A burn of the second degree which occupies only a limited extent of surface, but which destroys the epidermis entire, may end in recovery, while those of the third may, through their deep involvement, produce complications with which we are unable to combat. Burns occupying the abdomen give the highest mortality, while those of the thorax are only second to a slightly minor extent; but those of the head, neck, and limbs prove fatal in many instances.

The nature of the exciting medium often governs the termination of burns, and those produced by cohesive bodies cause the greater destruction of part or life. The length of time required for the partial or complete reparation of the surface may be an important question in medico-legal cases. This can only be governed by the type of injury, the length of contact of the exciting agent,

the nature of the affected person, and the general aspects of the case in question.

Treatment.—CONSTITUTIONAL.—The constitutional treatment is to be directed toward the relief of pain, the restoration of the depressed vitality at the time of accident, — *i.e.*, sustaining the system throughout the entire restorative process. Pain is best relieved by opium, or its alkaloid, morphine (preferably by hypodermic injection), because these agents have little, if any, depressing action upon the cardiac functions. The dose required will be much greater than ordinarily used, because of the sudden character and great amount of depression in these injuries.

Vitality must be restored as quickly as possible, and the use of ammonia (preferably carbonate), strychnine, and caffeine (because of their stimulating effect upon the cardiac muscle); hot drinks, such as milk and tea; alcoholic drugs in the form of whisky or brandy, and the production of local or generalized sweating. A most desirable plan of restoring heat is by using hot-water bottles placed at regular points so as to diffuse its effects. Other means, as, for instance, covering the body with a sheet and conveying heat through a pipe or by placing heated bricks beneath this covering. To keep the sufferer fairly comfortable during the local treatment stimulation must be kept up, care being taken not to produce overactivity and thus allow reaction to prove as deleterious as the effect of the burn.

The functions of the body must be regulated, the bowels being kept free or confined, according to the conditions present; the action of the kidneys should be watched. In some cases it may be wise to anæsthetize the patient during the first few hours immediately following the burn, and especially during the first dressings of aggravated cases.

LOCAL.—The local treatment is to be directed toward the limitation of the resulting inflammation, the prevention of septic infection, assisting the normal elimination of the eschar, the development of granulations, and limitation of the deformity.

In burns of the first degree little or no treatment may be demanded. In the more aggravated cases of this type the application of home measures, such as bicarbonate of sodium, the white of egg and sweet oil (equal parts), lead-water and laudanum, and the various hot or cold means generally at the disposal of housewives.

Burns of the second and third degrees must be more strenuously treated. It is often a difficult problem to know which is the more soothing application to be advised and from which we may get the better result. In one case hot applications, in another cold; in some wet, and in others dry, measures are to be given. The vesicles, if numerous, should be untouched; but if only a few, they are best evacuated. Prof. S. D. Gross was wont, in many mild and severe cases, to use ordinary white-lead paint; the results achieved were often marvelous.

The use of carbolized vaselin (15 to 30 grains to the ounce), watery solutions of carbolic acid (about 20 grains to the ounce), subnitrate of bismuth ($^1/_2$ to 1 drachm to ounce of ointment of zinc oxide or petrolatum), boric acid (either in watery saturated solutions or ointments of either zinc oxide or petrolatum in strengths varying from $^1/_2$ to 2 drachms to the ounce), bicarbonate of soda in almost full strength (in ointment or watery solutions), and starch in vary-

ing proportions will usually be found very efficacious.

Turpentine, where granulations are sluggish, will give excellent results used either in full or diluted strengths, giving care not to produce too much stimulation. H. L. McInnis states that spirit of turpentine applied to a burn of either the first, second, or third degree almost at once relieves the pain, while the burn heals. After wrapping a thin layer of absorbent cotton over the burn, the cotton is saturated with common turpentine and covered with bandages. Being volatile, the turpentine evaporates, and it is therefore necessary to keep the cotton moistened with it. When there are large vesicles, these are opened on the second or third day. It is best to keep the spirit off the healthy skin if possible to avoid the local irritation.

Surgery of this day has placed many excellent antiseptics at our disposal, and there is no better application than bichloride of mercury in the proportion of 1 or more grains, preferably the former, to 1000 parts of water and kept in constant contact, the dressings being made without removing the former cloths.

Acetanilid in full strengths of powder will be found effective, care always being given not to apply it over too great an area without watching its effect.

Ichthyol in watery solutions (1 or more drachms to the ounce), or in glycerin similar strength), or even in ointment form (with zinc oxide or petrolatum, about 1 to 3 drachms to the ounce) and the iodine derivatives, such as iodol, aristol, europhen (given preferably in ointment, 15 to 30 grains to the ounce of petrolatum or lard) are reliable measures.

Ichthyol is efficacious in treatment of burns of the first and second degrees. It allays the pain at once and slight superficial burns heal rapidly. In burns of the second degree with the formation of bullæ, even when extensive areas are involved, the remedy also acts favorably. It is used dry, diluted with zinc oxide or bismuth, the powder being spread evenly over the surface; in ointment (10 to 30 per cent.); or as a combination of these two methods. The powder is the most satisfactory form in extensive burns of the first degree, and should be plentifully applied. In extensive burns of the second degree the soft paste is preferable.

The zinc-oxide powder may be combined as follows:—

℞ Zinc oxide, 20 parts.
Carb. magnes., 10 parts.
Ichthyol, 1 to 2 parts.

While the paste is mixed as follows:—

℞ Carbonate of lime, 10 parts.
Zinc oxide, 5 parts.
Oil, 10 parts.
Lime-water, 10 parts.
Ichthyol, 1 to 3 parts.

Leistikow (Monat. f. prak. Derm., Nov. 1, '95).

Literature of '96 and '97.

Europhen, a preparation that contains about 28 per cent. of iodine, which it yields on exposure to moisture, is similar in action to iodoform, but has the advantage of having a less disagreeable odor. Again, it is less poisonous; does not become aggregated in masses, or "cake"; and is much lighter. It is, therefore, a valuable agent in burns. It may be employed in the form of powder, but a dressing consisting of 3 parts of europhen and 7 parts of olive-oil is to be preferred. As it only becomes active in the presence of moisture, its beneficial effects in the presence of secreting surfaces are obvious.

Europhen used considerably, employing the following combination:—

℞ Europhen, 1 part.
Vaselin,
Lanolin, of each, 10 parts.

This is applied three or four times a day to burns limited to rubefaction or vesication. Nolda (Gaz. Hebd. de Méd. et de Chir., July 11, '97).

Thiol has been found useful for all degrees of burn. According to Bidder,

it allays pain very rapidly and arrests cutaneous hyperæmia. In this manner it tends to prevent ulceration and scarring.

> Found especially valuable in burns of the second degree. Suppuration and cicatrices are avoided even after burns of the third and fourth degrees. The parts are first washed with a weak antiseptic solution, and the cuticle that may be hanging loose from ruptured blisters is removed, taking care to leave intact those that have not opened. After dusting the burn with boric acid the entire surface of the burned region and the skin around it are painted with a solution of equal parts of thiol and pure water. A layer of greased cotton is then laid on the burn, and kept in place with a loose bandage. Giraudon (Thèse de Paris, '95).

Aristol—which occurs in crystals of a light-reddish-brown color, soluble in water, slightly soluble in alcohol, and freely soluble in ether and fats—is another valuable agent in burns of the second and third degrees, and has been found strikingly effective where other remedies have failed.

> Pain is almost instantly relieved and healing is rapid. Haas (Deutsche med. Woch., p. 783, '94).

It may be used in the form of powder or mixed with oil or vaselin. The surface should be disinfected with a boric-acid lotion, and after opening the vesicles aristol is applied and the whole is covered with sterilized cotton-wool, gutta-percha paper, and a bandage. The application of aristol powder directly to the wound at the beginning hinders the dressing from soaking up the secretion; when the latter has diminished, however, aristol may be applied either alone or in a 10-per-cent. ointment with olive-oil, vaselin, and lanolin.

> Value of aristol in ulcerative processes occurring as a result of burns shown by the case of an engineer in whom a scald has caused excessive suppuration of legs, knees, and soles. An ointment of aristol changed the appearance in twenty-four hours, and the healing process continued steadily and with unusual rapidity. R. Y. McCoy (New England Med., Mo., Dec., '91).

Literature of '96 and '97.

The following may be used in the treatment of extensive burns:—

℞ Aristol, 1 part.
Sterilized olive-oil, 2 parts.
Vaselin, 8 parts.—M.

Around the edges of the burns, after the ointment is spread, he dusts the aristol in powder form. In burns of small extent he employs the powder form only. Cleanliness must be thorough whenever the dressing is changed. One of its great advantages is its freedom from poisonous effects. There is some smarting at first, but it soon passes off. Walton (Practitioner, July, '97).

Aristol may be used in all varieties of burns, from a simple erythema of the skin to a complete charring and destruction of the tissues. In the superficial form it is best used as a powder, while in the deeper burns the following ointment is to be preferred: Aristol, 1 part; olive-oil, 2 parts; dissolve and add vaselin, 8 parts. He considers strict asepsis of the wound, however, as the first essential to success. After pricking all the blebs and permitting the serum to exude, the burn should be well irrigated with a weak solution of boric or carbolic acid, and its surrounding scrubbed with soap and water. Then with sterilized absorbent cotton the surface should be gently dried, and the aristol applied, either as a powder or an ointment. If the latter is used, the wounded edges are first dusted with the powder, and then sterilized gauze on which the ointment has been thickly spread is applied. The dressing is completed with another layer of gauze, absorbent cotton, and a bandage. After three days this should be removed, the wound and adjacent parts asepticized as before, and the same dressing reapplied. By careful treatment in this manner very extensive burns will rapidly cicatrize.

Cookman (Hahnemannian Monthly, Mar., '97).

Of late the French surgeons have lauded picric acid used in saturated solutions with water (increasing the solubility by means of the addition of 1 ounce of alcohol, as the acid is soluble to the extent of only 2 drachms to the quart of water). They claim that it is particularly useful for the relief of pain and that it greatly assists the formation of granulations. I can subscribe to both of these statements, as many excellent results have followed its use in my hands.

Literature of '96 and '97.

Picric acid employed extensively, using a solution made by dissolving 1½ drachms of picric acid in 3 ounces of alcohol, which is then diluted with 2 pints of distilled water, a saturated solution being thus procured.

The clothing over the injured part should be gently removed, and the burnt or scalded portion should be cleaned as thoroughly as possible with a piece of absorbent cotton-wool soaked in the lotion. Blisters should be pricked, and the serum should be allowed to escape, care being taken not to destroy the epithelial surfaces. Strips of sterilized gauze are then soaked in the solution of picric acid, and are so applied as to cover the whole of the injured surface. A thin layer of absorbent cotton-wool is put over the gauze, and the dressing is kept in place by a light linen bandage. The moist dressing soon dries, and it may be left in place for three or four days. It must then be changed, the gauze being thoroughly moistened with the picric-acid solution, for it adheres very closely to the skin. The second dressing is applied in exactly the same manner as the first, and it may be left on for a week.

The great advantages of this method of treatment are: First, that the picric acid seems to deaden the sense of pain; and, secondly, that it limits the tendency to suppuration, for it coagulates the albuminous exudations, and healing takes place under a scab consisting of epithelial cells hardened by picric acid. A smooth and supple cicatrix remains, which is as much superior to the ordinary scar from a burn as our present surgical scar is superior to that obtained by our predecessors, who allowed their wounds to granulate. D'Arcy Power (Medico-Surg. Bull., Feb. 10, '97).

The advantages of picric acid are simplicity, painlessness, asepsis, small amount of discharge, infrequent dressings, astringent action in preventing inflammation, property of promoting the growth of epithelium, rapid separation of sloughs, absence of poisoning symptoms, and economy in dressings. It should cease when inflammation has subsided and granulations have formed. Miles (Brit. Med. Jour., July 17, '97).

Personal experience in fifty cases has shown that it is advisable to let the shreds of clothing which have been burned into the skin remain until the second dressing; the cloth having been aspepticized by burning, it will do no harm by remaining, while removal can only be accomplished by stripping away the flesh. The cloth will act as a capillary drain into the skin and it will promote a permeation of the acid solution into the injured tissue. At a second dressing the thoroughly-soaked fibres can be more easily removed. Dressings soaked in picric-acid solution do not adhere as much as other applications. Thompson (St. Louis Med. Review, Feb. 20, '97).

The saturated solution may be simply painted over the burnt surface with a large camel's hair pencil and the primary dressing, covered with oiled silk and cotton-wool, may be left on for a period of from three days to a week. The solution is used with much success in iron-foundries and sugar-refineries, a large bowl of it being kept in readiness for emergencies. Souter (Brit. Med. Jour., Jan. 2, '97).

Some French observers also claim that it is not poisonous, and that, excepting its effect upon the urine, which it turns very yellow, it has no other bad effects; but negative evidence has been adduced,

however, and several cases of poisoning (smarting at the part of application, with the production of vomiting in the course of twenty-four hours) have been recorded by Walther, Berger, Labouche, Tuffier, and others. Colic, diarrhœa, yellowish discoloration of the skin, sleepiness, and scanty, dark-colored urine were the main symptoms.

Calcined magnesia is a valuable agent for the treatment of burns of the first and second degrees.

Literature of '96 and '97.

The affected parts are covered with a thick layer of a paste, which is prepared by mixing the calcined magnesia with a certain quantity of water. This paste is allowed to dry on the skin, and when it becomes detached and falls off it is replaced by a fresh application. Very soon after the paste is applied the pain ceases, and under the protective covering formed by the magnesia the wounds recover without leaving the cutaneous pigmentation which is so often observed to follow burns that have been allowed to remain exposed to the air. Vergely (Revue Méd., Feb. 16, '96).

Iodoform is anæsthetic and antiseptic. It may be left *in situ* for a considerable period—a week—without necessitating a change of dressing. It should not be strewn upon the raw corium nor upon granulating tissues.

Literature of '96 and '97.

After accidents by burning, and particularly where the surface of the skin destroyed has been very extensive, atrophy of the optic nerves has resulted. It is also known that iodoform is capable of giving rise to a form of toxic amblyopia, resembling somewhat closely that produced by alcohol or tobacco. Whether these eye-symptoms be due to the burn in all cases, or to absorption of iodoform (and similar substances) applied to the wound, the possibility of the occurrence of a condition so very serious ought to be borne in mind. Terson (Arch. d'Opht., Oct., '97).

Nitrate of potassium, or nitre, has been found to be useful in all kinds of burns, and may be employed to great advantage when the other agents described cannot be had. It acts mainly as a refrigerant by causing notable lowering of the temperature of the liquid used as solvent.

Literature of '96 and '97.

If a burned hand or foot is plunged into a basin of water to which a few spoonfuls of the nitrate have been added, the pain ceases rapidly; if the water becomes slightly heated, the pain returns, but it is allayed as soon as a fresh quantity of the salt is added. This bath, which is prolonged from two to three hours, may bring about the definitive disappearance of the pain and even prevent the production of blisters. The application of the compresses also exercises the same influence. By this means the pain is allayed and cicatrization takes place without delay. Poggi (Revue Méd., Feb. 16, '96).

Any complication, such as bleeding, of small or large vessels, must be checked by appropriate surgical measures. Sepsis must be prevented by the early removal of any obnoxious material. Particles of dead skin laying over the surface are to be removed, clothing if present, if that can be accomplished without any further destruction of the tissues, thereby exposing the healthy parts, or producing pain to the sufferer.

Literature of '96 and '97.

Emphasis upon the great importance of keeping the injured part aseptic; the patient may recover from the shock only to die of blood-poisoning. This is especially to be feared where the side of the face and the chest are extensively burnt. The wound should be at once thoroughly disinfected. It is then covered with subnitrate of bismuth, and then with iodoform gauze, kept in place by light band-

ages. If the bismuth powder is found to irritate the skin and the raw surface, after it has been applied for a few days, it must be replaced by boric ointment. Every change of dressing should be made in a bath, in which the previous applications were allowed to soak off. Paul Tschmarke (Deutsche Zeit. f. Chir., vol. xliv, pp. 346-392, '97).

Granulations may often be assisted by powders of acetanilid in full strength, dusted over the surface, or by the use of some of the iodine derivatives, such as iodol, europhen, or aristol (15 to 60 grains to the ounce of powdered starch or ointment), applied to the exposed surface.

Limitation of deformity is a very serious problem. Splints are to be placed so as to prevent the parts from losing their anatomical relation and should be kept applied for some time after the parts have healed because of the inherent tendency of the contraction for long periods, even years, after the apparent cure. Bandages are to be kept continuously applied to prevent contiguous surfaces from becoming agglutinated. Massage must be advised at the very earliest moment so as to restore the pliability of the part and prevent ankylosis, when a joint is involved. Even with all the measures that we can adopt the loss of skin-tissue may be so extensive that skin-grafting will be the only means with which we can hope to restore the integrity of the part. The relief of cicatrices or contractions, ankylosis, or pressure upon the nerve-filaments sometimes requires the most energetic surgical interference.

J. Abbott Cantrell,
Philadelphia.

BUTYL-CHLORAL. See Chloral.

C

CADE. See Juniper.

CAFFEINE. See Coffee.

CAISSON DISEASE. See Paralysis.

CAJUPUT-OIL. — This is a bright-green, mobile, volatile oil had by distillation from the leaves of the *Melaleuca leucadendron* (*M. cajuputi*): a tree indigenous to the Orient. It has a strong camphoraceous odor and aromatic, bitter taste. A rectified oil is also obtainable, which may be colorless or of light-bluish-green hue, but with age is apt to turn yellow. With an equal volume of alcohol cajuput-oil affords a clear solution which either has a slightly-acid reaction or is neutral. The chief constituent is held to be *cajuputol*, which is claimed to be identical with eucalyptol, though this requires verification, therapeutically at least.

Preparations and Doses.—Cajuput-oil, 1 to 10 minims.

Essence of cajuput (oil of cajuput, 1; rectified spirit, 9), 10 to 60 minims.

Cajuput mixture (Hunn's life-drops: oils of cajuput, anise, cloves, and peppermint, of each, 1 part; rectified spirit, 4 parts), 30 to 60 minims.

Physiological Action.—Taken internally, oil of cajuput causes a sensation of warmth in the stomach, excites the action of the heart and arterial system, and subsequently induces copious diaphoresis. Externally, either alone or combined with equal parts of soap-liniment or olive-oil, it is rubefacient.

Therapeutics.—This is a remedy of much power and value, one too much

neglected in general practice. Unfortunately its therapeutic value is not understood, and its chemical relation, real or supposed, has done the drug great injustice. It is powerfully stimulant, carminative, stomachic, antispasmodic, anthelmintic, and antiparasitic; also has a slight narcotic and anodyne action.

Gout and Rheumatism.—When applied topically, and also given internally, in these affections, this remedy is often of the greatest service; it should be given by the mouth in 4- to 6-drop doses, as often as every second hour, and sometimes every hour in retrocedent gout, in which it is especially serviceable.

Intestinal Fluxes.—In cholera infantum, cholera nostras, Asiatic cholera, and the lesser intestinal fluxes, it has been greatly lauded, and while it often appears of incalculable value, it must be admitted that it is a somewhat uncertain remedy.

Nervous Diseases.—In hysteria it is sometimes beneficial, particularly hysterical dysmenorrhœa; also in those neuralgias that are of purely nervous type, *i.e.*, not dependent upon a localized inflammation.

Febrile Maladies.—In low fevers it is, perhaps, the best diffusible stimulant known, and it deserves far greater attention as regards this class of maladies than has been hitherto accorded to it.

External Use.—Externally applied, cajuput-oil is of value in the treatment of a number of skin maladies. It is also useful, oftentimes, in sprains and contusions, etc.

CALABAR-BEAN. See Ignatia.

CALCIUM.—This metal is not found in nature in its pure state, but appears in the mineral kingdom as marble, limestone, calcspar, gypsum, selenite, alabaster, fluorspar, apatite, phosphorite, etc.; in the animal kingdom as a phosphate and carbonate. It is present in all vegetables. Calcium is a light, yellow, very hard, malleable, and ductile substance that melts at red heat, tarnishes in air, and decomposes water. It is rapidly acted on by dilute acids, and when heated burns with a brilliant, white light. In medicine it appears only in the form of salts, and the physiological action is modified by the individual acid constituent.

Preparations and Doses. — Calcium bromide, 10 to 60 grains. See Bromine.

Calcium benzoate, 5 to 10 grains. See Benzoic Acid.

Calcium carbonate (precipitated), 5 to 40 grains.

Calcium chloride, 5 to 15 grains.

Calcium hippurate, 1 to 5 grains. See Hippuric Acid.

Calcium hypophosphite, 3 to 6 grains. See Hypophosphites.

Calcium iodide, 1 to 4 grains. See Iodine.

Calcium lactate, 1 to 5 grains. See Lactic Acid.

Calcium phosphate (precipitated), 10 to 30 grains. See Phosphoric Acid.

Calcium sulphate (gypsum). See Plaster of Paris.

Calcium sulphide, $^1/_{10}$ to 3 grains.

Calcium sulphocarbolate, 2 to 5 grains. See Sulphocarbolates.

Calcium salicylate, 2 to 8 grains. See Salicylic Acid.

Calcium hypophosphite, syrup, 1 to 4 drachms.

Calcium iodide, syrup, 15 to 30 minims.

Calcium lactophosphate, syrup, 2 to 4 drachms.

Lime-water, 1 to 4 ounces.

Lime-water, chlorinated, 30 to 60 minims.

Physiological Action.—Lime neutralizes any excess of acid in the stomach and intestines. It is but slowly absorbed and passes into the blood only in small quantities, although sufficient is taken up to promote nutritional changes. It also exerts a digitalic action on the heart: when the proportion of lime present is deficient, the contractions are weak; but when the quantity is increased they become powerful. It is eliminated by the intestines, and to some extent by the kidneys, inasmuch as the urine becomes alkaline under its administration.

Pure precipitated carbonate of calcium appears to be medicinally of less value than the impure form, which obtains the names of "precipitated" and "prepared chalk"; both are neutral salts and antacids, but the latter is more astringent.

Calcium chloride is stimulant, astringent, alterative, resolvent, and antiseptic. Calcium sulphide acts very much like the chloride, but is more powerful. The effects of both depend upon their power to readily and quickly part with their gaseous constituents, viz.: chlorine and sulphuretted hydrogen, respectively. The former is more powerfully irritant and cathartic.

Lime-water is chiefly antacid, but at times appears to act as a sedative to the gastric viscus. It, as well as certain of the lime salts, not infrequently gives rise to disturbance of digestion and loss of appetite; vomiting has been observed to follow its employment. There may be an increase in the amount of urinary secretion, but the stools are usually retarded, though sometimes diarrhœa is a result.

Therapeutics. — Diarrhœas. — Precipitated chalk is chiefly employed for its neutralizing effect upon the acid secretions of the *prima viæ*; hence finds place among the remedies recommended for the diarrhœas of infancy and childhood; it is also astringent, and usually prescribed in conjunction with opium. It is not, however, the valuable remedy claimed by earlier writers, and its place, to considerable degree, has been most advantageously usurped by bismuth subcarbonate and cerium oxalate; further, the more modern treatment of intestinal fluxes is directed toward removal of cause, rather than, as formerly, combating a mere symptom.

Calcium chloride—not calx chlorata—has on several occasions been relegated to the list of obsolete remedies, but as often has been again brought forward. There is very little difference in therapeutic applicability from that of calcic sulphide, except in degree of activity and size of dose; therefore the remarks regarding one may be safely considered as equally true of the other.

As Alteratives and Resolvents.—Both are applicable to a number of maladies, chiefly those of a strumous, septic, or pseudoseptic character; they have likewise been employed to some extent in the different forms of tuberculosis.

Literature of '96 and '97.

Calcium chloride is frequently given in phthisis and in the wasting diseases of children. It is freely soluble in water, and the solution may be flavored with glycerin. Murrell ("Manual of Phar. and Ther.," '96).

There is not the slightest doubt that in many instances it will abort furuncles, but the most marked effect of calcium chloride is in acne. All strumous cutaneous affections, especially lupus, are often benefited by it. The caries and necrosis of the same diathesis, rickets, indulated glands, and tabes mesenterica are also conditions in which it may be employed with some expectation of benefit. Ovarian and uterine tumors are reported to have decreased

in size under long-continued use of the drug. It is also a powerful irritant and cathartic.

There seems to be little question that all suppurative processes are modified by calcium sulphide in a most decided manner, ichorous pus being rendered laudable and abscesses hastened to maturation when once established, or aborted if taken in time. Acne and all suppurative skin disorders are benefited by it, as well as glandular enlargements of the strumous and scrofulous. Nevins (Foster's "Prac. Ther.," vol. i, '96).

PNEUMONIA.—In the past the remedy has been much lauded in pneumonia, and lately it has again been recommended in this malady.

Literature of '96 and '97.

In lobar pneumonia calcium chloride reduces temperature and keeps it within safe or normal limits in spite of the continuance of physical signs. Moreover, there is a tendency for the morbid process to be arrested at whatever stage the drug is given in efficient doses, whereby the course of the disease is shortened or rendered milder. Also there is singular freedom from all anxiety, distress, and danger: a freedom not usually associated with continuous high temperature. Crombie (Practitioner, London, '96; Med. Age, Mar. 10, '96).

THE EXANTHEMATA.—Its value in eruptive diseases is, perhaps, overrated, yet the external application in weak solution is a common domestic practice. The chemical decomposition that takes place within the economy certainly demands some consideration of the claims made regarding internal administration.

Literature of '96 and '97.

In all itching skin diseases calcium chloride may be given after meals. There are no absolute failures, but it remains to be determined in what class of cases it is most useful. Saville (Brit. Med. Jour., vol. i, '97).

Employed calcium sulphide in an epidemic of measles and it proved ameliorating, abortive, and prophylactic. In some adult cases where the eruption was very dark and typhoid symptoms present, 1 grain every two hours easily controlled all the unpleasant symptoms. It is probable that scarlet fever, and even small-pox, may be rendered mild, if not aborted, by the early use of this remedy. Silvers (Med. Age, Mar. 25, '97).

INFLUENZA.—In doses of 1 grain daily calcium sulphide has, on various occasions, shown a very favorable action over influenza, and not infrequently the attack is aborted.

CALCULI, BILIARY. See CHOLELITHIASIS.

CALCULI, SALIVARY. See SALIVARY CALCULI.

CALCULI, VESICAL. See VESICAL CALCULI.

CALOMEL. See MERCURY.

CAMBOGIA. See GAMBOGE.

CAMP FEVER. See TYPHUS FEVER.

CAMPHOR.—This is a peculiar, concrete, volatile substance obtained by sublimation from the *Cinnamomum camphora*: a native of China, Japan, and some of the isles of the East Indian Archipelago. Camphor is also found in white crystals in the fragments in the wood of *Dryopalanops camphora*. It appears in small quantities in various other plants, and Tenasserim camphor, which is of fair quality, is a yield of the leaves and stalks of *Blumea grandis* (or *campher*). It is sparingly soluble in water, but freely so in alcohol, ether, chloroform, and fluid and volatile oils; with chloral or carbolic acid it forms a clear liquid. As found in the shops, it is a white, translucent gum of tough, almost crystalline structure, possessed of a pungent, bitter taste that leaves in the

mouth a feeling of coolness. Camphor is incompatible with acids, iodine, etc.

Camphoric acid is formed by oxidation of camphor with nitric acid, and appears as a white, microcrystalline powder, very slightly soluble in water, with a faint aromatic odor and slight, saline, camphor taste.

Camphor-chloral is merely a mixture of equal parts of gum-camphor and chloral-hydrate whereby is produced a colorless, syrupy liquid, which is soluble in alcohol, ether, chloroform, benzin, glycerin, fixed oils, and aqueous solutions of chloral; but when added to water it is decomposed, the chloral passing into solution, while the camphor is precipitated.

Camphor-menthol is made by rubbing together equal parts of menthol and camphor whereby a clear liquid is formed. Camphor-thymol is made in the same way, precisely, as camphor-menthol. Other compounds are formed in like manner of the two foregoing by combining camphor and salol and camphor and resorcin. Camphor-oil is a crude residual product resulting from the distillation of camphor-gum.

Camphor-ball is merely a form of "camphor-ice," so called; it is made by melting 4 parts of spermaceti, 12 parts of white wax, and 5 of oil of sweet almonds, on a water-bath, adding to it, while hot, 4 parts of gum-camphor. A better preparation, however, is to make the foregoing with equal parts of each of the ingredients.

Camphor-monobromate, or monobromated camphor, is had by heating camphor-gum and bromine, previously dissolved together in benzin, and then crystallizing from hot alcohol; it is almost insoluble in water, but readily dissolves in alcohol, chloroform, ether, and fixed oils.

Camphor-salicylate may be prepared by heating together carefully 84 parts of camphor and 65 parts of salicylic acid, until a liquid, homogeneous solution is formed, which becomes a crystalline mass on cooling; this again becomes unctuous when compressed, and liquefies when rubbed on the skin. It may be obtained in definite crystals from a benzin solution. It is slightly soluble in water and glycerin, about 1 to 20 in fats or oils, and is decomposed by hot alkaline solutions. By boiling with water it hydrates into an oily liquid.

Camphoid is a solution of 1 in 40 of gun-cotton (pyroxylin) in equal parts by weight of camphor-gum and alcohol. It has been proposed as a substitute for collodion.

Carbolized camphor, or phenol-camphor, is had by adding 2 parts of camphor-gum to 1 part of carbolic acid, and is a colorless, oily liquid, soluble in fixed oils, alcohol, and ether, but nearly insoluble in water and glycerin.

Preparations and Doses. — Camphor-chloral, 2 to 20 minims.

Camphor, carbolized, external use only. See PHENIC ACID.

Camphor-gum, 2 to 20 grains.

Camphor-liniment (camphor, 1; olive-, peanut-, or cotton-seed oil, 4).

Camphor liniment, compound (camphor, 20 drachms; lavender-oil, 1 drachm; strong ammonia-water, 5 ounces; rectified spirit, 15 ounces).

Camphor-menthol, 1 to 5 grains.

Camphor, monobromated (bromide of camphor), 1 to 12 grains.

Camphor-oil (crude), external use only.

Camphor, salicylated (salicylate of camphor), 1 to 5 grains.

Camphor spirit (tincture of camphor), 5 to 30 minims.

Camphor-thymol, 1 to 5 grains.

Camphorated oil (camphor, 1; sweet almond oil, 9), 5 to 60 minims.

Camphorated tincture of opium (paregoric), 30 minims to 4 drachms. See Opium.

Camphoric acid, 5 to 30 grains.

Camphoid, external only.

Tully's powder (camphor, 3; opium, 1; powdered licorice-root, 3; powdered soft carbonate of lime, 3 parts. Or $^1/_6$ grain of morphine acetate or muriate may replace 1 grain of opium), 1 to 10 grains.

Physiological Action. — Externally camphor is somewhat rubefacient, readily irritating the skin. Given internally, it acts chiefly upon the brain, cord, and circulatory apparatus. In small doses it increases the action of the heart and arteries: the pulse is rendered softer and fuller. It exhilarates the spirits, and excites warmth of body, promoting diaphoresis; but these effects are transitory and fleeting and apt to be followed by depression. In larger doses it is sedative, antispasmodic, somewhat hypnotic and analgesic, and sometimes markedly anaphrodisiac. In poisonous doses it irritates the gastro-intestinal mucous membrane; induces nausea, vomiting, vertigo, delirium, maniacal excitement, and convulsions of an epileptiform character; cardiac prostration and muscular weakness are often very pronounced. It is antidoted by emetics, rapid-acting cathartics, and stimulants.

Camphor-chloral combines the virtues of the two drugs from which it is derived; it is sedative, hypnotic, and narcotic.

Monobromated camphor is moderately stimulating and diaphoretic, but is scarcely a *succedaneum* for other bromides; it decidedly lowers temperature; is anodyne, antispasmodic, and narcotic; in large doses, sedative. In very large doses it depresses and weakens the heart's action.

Salicylated camphor acts very much like monobromated camphor; it is less antiseptic, however, and more analgesic. Very large doses of either this or the monobromated form induce muscular trembling and clonic convulsions.

Camphoric acid is antiseptic, somewhat diuretic and astringent, and antisudorific. It is eliminated chiefly by the urine, which it renders clear and acid.

The physiological action of the other preparations is not sufficiently differential to require mention.

Therapeutics.—As an Antigalactagogue.—The external uses of camphor are many and varied, and exemplified in almost every household. The tincture applied to the breasts of the nursing woman proves markedly antigalactagogic: an effect which is heightened and materially aided if the same is also administered at the time by the mouth.

Literature of '96 and '97.

The most desirable method is to diminish the patient's drink, administer purgatives, and place over the breasts an ointment or liniment of camphor; to also give camphor internally in doses of 1 or 2 grains, once, twice, or thrice daily. When both the external and internal treatment by camphor are resorted to, the decrease in the secretion of milk is quite remarkable. Herrgott (Indép. Méd.; Med. Age, '97).

Febrile and Infectious Diseases. —In low forms of pyrexia camphor is often a remedy of great value. A solution in acetic acid was at one time held to be an almost specific in common continued, pestilential, exanthematic, and puerperal fevers; and even yet it is admitted to be of great value, but difficult to administer. It is, however, contraindicated where there is either a flesh-

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red tongue or tenderness of the abdomen with diarrhœa. Latterly, more especially in Europe, the hypodermic administration of camphor dissolved in sweet almond oil is lauded in these maladies; also in asthenic and advanced stages of acute inflammations when the vital powers are greatly exhausted, and in delirium accompanied by depressed nerve-energy; but it sometimes requires to be reinforced, so to speak, by other stimulants and sedatives. In the main, however, the administration hypodermically has little to commend it over ingestion by the stomach.

In infectious diseases, the exanthemata, pleuro-pneumonia with meningeal symptoms, in infectious endocarditis, etc., more especially if the patient is in a condition of collapse, 15 to 45 minims of a 10-per-cent. solution of camphorated oil afford prompt relief, employed subcutaneously. Even so much as 15 grains of camphor daily, far from aggravating, ameliorated cerebral symptoms. From 7 to 15 grains produce remarkable restorative effects. Schilling (La Méd. Moderne, Nov. 30, '95).

In influenza, pneumonia, typhoid, broncho-pneumonia, etc., camphorated oil yields good results, but should be administered before the patient is too weak; it produces an increase of arterial pressure, free expectoration, and a feeling of physical well-being. If given by the mouth its taste may be disguised by essence of peppermint. It appears to be contra-indicated where there is great cerebral excitement. Tuassia (Gaz. deg. Ospitali, Mar. 8, '92; Brit. Med. Jour., Mar. 26, '92).

Camphorated oil produces the most remarkable effects in follicular angina, coryza, and acute pharyngo-laryngitis; in bronchitis it is a good expectorant; in fibrinous pneumonia it diminishes temperature and notably ameliorates the general condition. It is also serviceable in chloranæmia and in phthisis during the period of softening with ulceration, night-sweats, and hectic fever. In tuberculosis of the larynx the pains in the throat are notably diminished. Favorable action is likewise observed in hæmoptysis. Alexander (Berliner klin. Woch., '92; Med. Age, Mar. 25, '92).

In small-pox and other exanthemata, when the eruption has receded, camphor in small and oft-repeated doses frequently causes restoration; but if there is inflammation of important viscera the drug is contra-indicated.

Mental and Nervous Diseases.—In the past, camphor obtained a foremost place in the treatment of insanity, and there is every reason to believe it is now too much neglected. When the patient is of nervous temperament, or there is deficient nerve or vital power; when the head is cool and the mental affection independent of vascular fullness or action; when there is much restlessness, low, weak pulse, or cold, clammy skin; or when exhaustion follows the foregoing or is superimposed on previous excitement, the drug may usually be given to marked advantage; but it is not to be advised when there is cerebral excitement with a hot skin, full pulse, and wild countenance. In puerperal insanity, especially, it is frequently of the most service; but here, as in all other conditions of mental alienation, it requires to be employed with discrimination.

Diseases of the Heart.—In heart-maladies camphor is occasionally very beneficial; it will frequently quiet tumultuous palpitations and remove the dyspnœa which often attends hypertrophy with dilatation.

Literature of '96 and '97.

Camphor is to be recommended hypodermically in heart-failure, preferably employing camphorated oil. In a case in which the patient had a number of times been absolutely pulseless and apparently lifeless its use was followed by

the most gratifying results. West (Phila. Polyclinic, Oct. 16, '97).

General Maladies.—In the management of asthma, skin diseases, nymphomania, chordee, and spermatorrhœa camphor finds a prominent place.

The drug is not appreciated for its real worth in skin diseases. In anal and pudendal pruritus it may be employed both internally and topically. In all vesicular, exudative, pruriginous affections, such as eczema, pemphigus, erysipelas, and intertrigo, the pain, tension, and burning are relieved by a powder of: camphor, 4 parts; oxide of zinc and powdered starch, of each, 48 parts. Furuncles may be aborted by an application of tincture of camphor on absorbent cotton. The same measure will also destroy pediculi. Phillips (Med. Times and Hos. Gaz., vol. xxi, '94).

Camphor is also able to control the salivary secretion, and may advantageously be used in disorders in which the salivary ducts are occluded.

Case of a patient who received an injury of the face severing Steno's duct, causing salivary fistula. In a few days the discharge of saliva ceased, and the cheek became enormously swelled from pressure on the duct. Under the influence of a camphor ointment the secretion of saliva was checked, the swelling disappeared, the inflammation around the wound grew less, and in a few days complete recovery was had. Maire (Amer. Lancet, Jan., '88).

Intestinal Fluxes. — Camphor, either in powder or tincture, is an excellent and popular remedy for the diarrhœas of summer and autumn, which so often assume a choleraic form. When the body is cold as ice, there is great prostration, the voice squeaky and husky, and the upper lip retruded, the effect of the remedy is said to be often marvelous.

Literature of '96 and '97.

It is essential to use the strong solution or essence (spirit) of camphor, of which 3 minims should be given on a cube of sugar or on a crumb of bread every five minutes. After one or two doses the diarrhœa ceases, the pulse becomes stronger, color returns to the face, and the patient is on the high road to recovery. The tincture is almost equally useful in the initial rigor of acute specific diseases and in severe chill. Murrell ("Manual of Mat. Med. and Ther.," '96).

Few, if any, remedies are comparable to camphor in summer diarrhœa and cholera. Its benign influence in the latter disease is most conspicuous, for it generally checks the vomiting and diarrhœa immediately, prevents cramp, and restores warmth to the extremities. It must be given at the very commencement, and repeated frequently, otherwise it is useless. Four to 6 drops of the strongest tincture should be given every ten minutes until the symptoms abate, and then hourly. Ringer and Sainsbury ("Hand-book of Ther.," '97).

Monobromated and salicylated camphor have been employed in diarrhœa, dysentery, epilepsy, chorea, hysteria, asthma, neuralgia, etc. Not one is as marked in stimulant action as the camphor-gum or tincture, but the monobromate is an hypnotic of considerable power and an invaluable antispasmodic.

Combined with belladonna and gentian, monobromated camphor may be recommended in epilepsy. Black (Phila. Med. and Surg. Reporter, Mar. 3, '88).

There is no better remedy than the monobromate in the treatment of infantile diarrhœa and the convulsions of dentition. Curryer (Chicago Med. Times, July, '91).

Marked success is had in relieving chordee by using suppositories of camphor-monobromate. Vanderbeck (Pacific Med. Jour., June, '91).

Salicylated camphor is said to be of marked utility when applied in the form of ointment to lupus and rodent ulcer. It is also employed in diarrhœa, but is in no way superior to the monobromate.

Camphor-chloral has found its chief employment in mania, delirium tremens, etc. It is said that the sedative effect is far in excess of that of either of its constituents. Prolonged narcotism, lasting several days, had followed excessive use of the drug. Applied topically it is often effective in relieving neuralgic pains.

Phenicated camphor was originally introduced as an anæsthetic and as an antiseptic dressing, but seems to have found favor with some in the management of skin maladies.

Phenol-camphor is a powerful local anæsthetic when applied to abraded surfaces or when a few drops are injected under the skin. Applied on absorbent cotton to a wound, it prevents suppuration. It will abort boils; if mixed with an equal quantity of sulphuric ether and injected into a boil the latter is quickly aborted. In a case of herpes of the leg one thorough application entirely relieved the burning, itching, and pain. Cochran (Ther. Gaz., Dec., '88).

Literature of '96 and '97.

It is a useful application in toothache due to an exposed and inflamed pulp. A valuable deodorant to correct the fœtor arising from syphilitic ulcerations, malignant growths, gangrene of the lungs, bronchorrhœa, and pneumothorax. It reduces the discharge and relieves the pain in acute otitis media; a 10-per-cent. solution in glycerin should be used. Also available in otorrhœa and in acute perforation of the tympanic membrane in 1- or 2-per-cent. solution. Is an efficient antiseptic in foul and indolent ulcers, and may be used in the form of a lotion: 8 to 15 grains to the ounce. Butler ("Text-book of Mat. Med., Ther., and Phar.," '96).

Thymol-camphor has been suggested as a preparation that would be valuable in dermatological practice, but has received, apparently, but little attention.

Literature of '96 and '97.

Used in pruritus of scrotum and in pediculosis pubis with apparently good results. Applied to the normal healthy skin, it does not cause any irritation or redness. Schaefer (Boston Med. and Surg. Jour., '96).

Menthol-camphor is very like the foregoing. It has been exploited for the treatment of catarrhal maladies, including "hay" asthma or fever, acute laryngitis, etc.

In hypertrophic nasal catarrh, with excessive and disordered secretion, a 25-per-cent. solution of the drug has given excellent results. It was equally effective in chronic hypertrophic rhinitis, as well as in eczematous and herpetic eruptions. Bishop (Kansas City Med. Index, Mar., '92).

Camphoric acid is one of many remedies introduced with a view to treating tuberculosis by destroying bacilli, but it has failed to fulfill the rôle laid down for it. Latterly it has been employed in a host of nervous diseases, and as a remedy against night-sweats, cystitis, etc., and it has appeared to be of some value in the management of epilepsy.

Useful in night-sweats of phthisis, chronic cystitis, catarrhal affections of larynx and nares, and as an inhalation in bronchitis. Nissel (Deut. med. Woch., Oct. 4, '88).

In thirty-five cases of cystitis the influence was not so much on the catarrh producing the pus as on the decomposition taking place in the urine. In 50 per cent. of cases of phthisis where it was employed to control night-sweats it had decided influence; but little faith is to be put in it as regards other tubercular troubles or in angina. Fürbringer (Deut. med.-Zeit., June 21, '88).

Ordinary angina and catarrhal pharyngitis were much improved by gargles of ½- to 1-per-cent. solution; applied by brush or as a spray, in fourteen cases of laryngitis it gave excellent results. Proved gratifying in cystitis, but its

inhalation in lung diseases was without noticeable effect. Hurtleib (Wiener med. Presse, Feb. 23, '90).

It is a powerful innocuous antiseptic, especially in gonorrhœa, cystitis, and diphtheria. A dose of ½ drachm in one case induced gastric irritation and vomiting. Warman (Gaz. lekar., No. 36, '89; Prov. Med. Jour., Jan., '90).

Nothing new in literature has been presented regarding this drug since the appearance of the foregoing.

Camphor-oil has never found a definite place in medicine except domestically, and then for external use only. Latterly, however, a few spasmodic attempts have been made to give it place, and suggestions have been thrown out regarding its internal adminstration. It is a crude product of uncertain strength, and it can serve no purpose that cannot be better filled by a solution of camphor-gum in oil of sweet almonds.

CANCER. See TUMORS.

CANCRUM ORIS. See MOUTH.

CANNABIS INDICA SEU SATIVA.—Indian, European, and American hemp are one and the same, except as modified by locality, climate, soil, and culture. The plant attains its highest medicinal virtues when grown in the tropics or subtropics, inasmuch as here it develops a larger amount of resin (*churrus*). The dried flowering tops of the female plant are the parts employed medicinally, and it is essential to medicinal virtue that the resin be not removed; these tops in their crude condition are known as *gunjah*. The Arabian *hasheesh*, Hindoo *bhang*, and Mohammedan *majoon* are practically identical, being aromatic confections into which not only cannabis Indica, but the powdered seeds of stramonium, enter. *Hasheesh* is not, as has been stated, "the broken stalks of the hemp made up into fruits."

The chemistry of hemp is not well understood. The resin, or *churrus*, according to Egasse, is the active principle, and has received the name of "cannabin"; but Helbing gives this title to a supposed alkaloid of syrup-like consistency and brownish- or greenish- black hue, scarcely at all soluble in water, but freely so in ether and alcohol. Jahns insists that the only alkaloid is choline, and all other supposed principles are impure choline. Inasmuch as this same name obtains to a base found in plants and animals, formerly known as "sinhaline" and "bitineurine," and described chemically as oxy-ethyl-trimethyl-ammonium, its applicability is questionable.

Cannabindon is another derivative of hemp, and appears in the form of a dark, cherry-red syrup.

The cannabine alkaloid of Merck is had in fine needles, but its relations to the entire drug are not yet fully determined; it is not even known that it is a true alkaloid. So, too, there is found in market another "alkaloid" bearing the same title, and which is a translucent, brown, syrupy liquid, with the hemp odor.

Cannabine tannate is a yellowish-brown powder with a tannin-like taste, not unpleasant smell, insoluble in pure water and ether, soluble in alcohol, and freely so in water made alkaline; it is said to be free from the two acrid and volatile oils peculiar to hemp and which are generally held to be rapidly-acting irritant poisons. Cannabinine is a yellowish-brown, syrupy liquid with an odor very similar to that of nicotine. Cannabindon is a purified churrus of dark-brown color, the consistency of treacle, and a most disagreeable taste; it is insoluble in water.

In the Orient churrus is smoked, and also manufactured into an intoxicating drink. A butter is also employed in the Hindoostani peninsula, made by boiling together equal parts of *ghee* and cleansed hemp-herb, until the small amount of added water is all absorbed; while warm it is pressed through loosely-woven linen into a vessel filled with cold water; and this butter, which is of a green hue, is frequently washed again either with pure water or rose-water. Sometimes a certain quantity of cleaned hemp-herb is boiled in equal parts of water and of milk until the whole is reduced by evaporation to one-half its original bulk, then strained and curdled. The butter is afterward, in the usual manner, separated from the coagulation, and contains the effective (*i.e.*, resinous) part of the herb. The butter, too, is often flavored with spices and sugar, and by means of gum-tragacanth converted into bon-bons or lozenges. The latter were attempted to be introduced into medical practice in France by the late Germain Sée.

Preparations and Doses.—As a whole, cannabis is one of the most valuable of drugs, but is sadly handicapped by the uncertainty that attends all pharmacopœial preparations. Attempts to prepare by methods of assay have not been attended with any marked degree of success, owing to the fact that such have necessarily been based on the amount of the extractive. Too little is known regarding the so-called active principles to place any reliance on them as guides; consequently the sole dependence of the prescriber is the character of the manufacturer, and the ability of the latter to judge of the crude drug employed. For such reasons cannabis requires to be employed with judgment and caution. It has been noted, too, that larger doses are required in temperate climes than in the tropics and subtropics to produce a definite effect; but the real truth, doubtless, lies in the fact that the drug deteriorates with age and by transportation; perhaps loses some undetermined volatile constituent. The same precise preparation may prove active to-day; but, given to the same patient under equally favorable conditions a few weeks later, may prove practically inert. Honiberger observed that a resinous extract prepared for him in Calcutta was very much less energetic when he reached London.

Cannabis Indica abstract, $^1/_2$ to 4 grains.

Cannabis extract (solid), $^1/_4$ to 2 grains.

Cannabis extract (fluid), $^1/_2$ to 6 minims.

Cannabin (resin), 1 to 5 grains.

Cannabindon, $^1/_2$ to 1 minim.

Cannabine (alkaloid), $^1/_2$ to 4 grains.

Cannabin tannate, 2 to 15 grains.

Cannabine (liquid), 1 to 3 minims.

Cannabinine, $^1/_4$ to 1 grain.

Cannabis tincture, 5 to 30 minims.

Cannabis-butter, 2 to 8 grains.

Liquor cannabis (Lees's), 15 to 60 minims.

> Excellent results may be had from the use of a strong aqueous extract of the flowering tops of the female plant of the usual strength of liquid extracts. It possesses the anodyne and soporific action generally ascribed to the resin, although in a modified degree; has the characteristic odor of hemp and a beautiful deep-amber color; and, above all, is miscible with other liquids. It offers all the benefits, but none of the drawbacks, of the tincture, avoiding those extreme exhilarating conditions bordering on intoxication that are sometimes met with. It does not interfere with the secretion of mucus from the bronchial glands: a circumstance which renders it superior to opium preparations. R.

Cowan Lees (Brit. Med. Jour., Feb. 9, '95).

Physiological Action.—The alkaloids appear to be purely hypnotic in action; but all other preparations exhibit, in a general way, the action of the crude drug. Minute doses are sedative to the spinal centres, and even when frequently repeated exhibit little to be remarked, except, perhaps, there may be slight contraction of the pupils; but there is, nevertheless, inculcated a feeling of comfort and well-being, and not infrequently the drug appears to steady the action of the heart. Larger doses are stimulant; they first induce increased arterial action, followed by exhilaration, and, as the latter passes off, drowsiness or stupor succeeds, that may be almost cataleptic; but the awakening is free from *malaise*, nausea, headache, or other untoward symptoms; the pupil of the eye is expanded. The preliminary effect is more powerful and lasting than that of opium, and the slumber it induces is commonly disturbed by dreams and spectral illusions. Also the sensory nerves are affected, as is evidenced by marked numbness and tingling, ushering in cutaneous anæsthesia and diminution of the muscular sense. Appetite is generally stimulated, and marked aphrodisia is not uncommon. Withal it is a valuable anodyne and antispasmodic, its influence being manifested through the brain and cord.

Cannabis Indica likewise exhibits a marked predilection for the genito-urinary apparatus, being strongly stimulant or sedative to the mucous tissue thereof in accordance with the mode of exhibition and size of dose; it is sometimes markedly diuretic, and appears to be excreted in part by the kidneys; but beyond this the eliminative process is unknown. Further, in atonic conditions or inertia during labor, it stimulates uterine activity and induces physiological contractions, and at a time when ergot and kindred remedies prove useless.

Poisoning by Cannabis Indica.—In large doses the drug appears toxic, and yet, strange to say, in spite of the enormous quantities (relatively) that have been ingested on certain occasions, either accidentally or purposely, a case of death directly referable to this drug has yet to be recorded.

Treatment of Poisoning.—Cannabis is antagonized by caustic alkalies, vinegar and other acids, strychnine, electricity, antimonials, and blisters to the nape of the neck.

Therapeutics.—Hemp is soporific or hypnotic, anodyne, antispasmodic, nervine stimulant, and, as already remarked, in some measure diuretic, aphrodisiac, and oxytocic; consequently its scope of usefulness is a most extended one, particularly in nerve-maladies.

> Its most important effects are to be found in the mental sphere, as, for instance, in senile insomnia with wandering. An elderly person (perhaps with brain-softening) is fidgety at night, goes to bed, gets up, thinks he has some appointment to keep, that he must dress and go out; daylight finds him quite rational again. Here nothing can compare in utility to a moderate dose of cannabis. In alcoholic subjects, however, it is uncertain and rarely useful. In melancholia it is sometimes serviceable in converting depression into exaltation. In the occasional night-restlessness of paretics, and the "temper disease" of Marshall Hall, it has proved eminently useful. In neuralgia, neuritis, and migraine it is, by far, the most useful of drugs, even when the disease has persisted for years; many victims of diabolical "sick headache" have for years kept their sufferings in abeyance by taking hemp at the threatened onset of the attack. It relieves the lightning

pain of ataxia, and also the multiform miseries of the gouty. Again, in chronic spasm, whether epileptic or choreic, it is of great service; also in the eclampsia of both children and adults. In brain-tumors or other maladies in the course of which epileptic seizures occur followed by coma, the coma being followed by delirium,—first quiet, then violent, the delirium then passing into convulsions, and the whole gamut being repeated,—Indian hemp will at once cut short such abnormal activities, even when all other treatment has failed; but in genuine epilepsy it is of little avail. J. Russell Reynolds (Lancet, London, Mar. 2, '90; N. Y. Med. Jour., June 7, '90).

In tetanus cannabis Indica has been found very efficacious at times, and in those cases wherein it is not curative it seldom fails to afford some measure of relief.

Hay-fever.—The usefulness of hemp in allaying morbid irritability of the nervous system is such that it has been suggested for employment in the form of vasomotor coryza popularly denominated "hay fever" or "hay asthma"; but there seems to have been no critical trial thereof. The idea, however, is both commendable and rational, and worthy of experiment. Cannabis is often efficacious in other asthmas, either given by the mouth or burned and its fumes inhaled.

Delirium Tremens. — In *delirium tremens* the drug is often most satisfactory; here its action resembles opium and wine, but is much more certain. It produces a great change of mind in the patients, readily dissipates the horrors, quiets nerve-hyperæsthesia, and conduces to cheerfulness; but great discrimination is necessary in application.

Uterine Hæmorrhage.—In menorrhagia and other uterine fluxes hemp is often invaluable if judiciously employed; and so, too, it may prove valuable in impending abortion. Mention has already been made of its power upon the gravid womb inactive through inertia, and it is equally efficacious as a preventive of post-partum hæmorrhage or as a remedy after "flowing" has begun, but requires to be given in full dose and sometimes in conjunction with ergot. Here half-drachm or even drachm doses of the fluid extract may be exhibited, since—strange to say—in such cases it never exhibits the ordinary physiological effects; there is no excitement, no intoxication, and no tendency to somnolence; only a feeling of quiet well-being, and that the condition is one of perfect safety.

Effect upon Reproductive Organs. —Cannabis, too, is especially available for sensitive ovaries. Indeed, it seems sedative to all the pelvic contents; and it is thus that it acts as an aphrodisiac by allaying functional nerve irritation, not, as has been supposed, by stimulating erethism; and yet the latter effect may be had from large doses, but is apt to be most fleeting or else assume the form of a priapism in man and nymphomania in woman that is not gratified, much less satisfied, by sexual indulgence.

It exerts a very marked effect upon the reproductive apparatus. In the early stages of gonorrhœa small doses combined with gelsemium will subdue the disease much sooner and more safely than the old method of ruining the digestive powers with large doses of copaiba and turpentine. Combined with gelsemium it subdues inflammation of mucous tissue. In spermatorrhœa in highly nervous subjects it is especially valuable. It will do good service combined with pareira brava in cases of irritable bladder. Goss ("Text-book of Mat. Med., Phar., and Special Ther.," '89).

Cholera. — In the Orient it is a favorite remedy for epidemic cholera;

patients in actual collapse have revived after taking a full dose. It seems to stimulate the nervous centres at a period when their influence is all but suspended. It is by no means a universal panacea as regards this malady, and seems to little affect the dark races, probably because they are generally more or less habituated to its use.

Cardiac Diseases.—In violent palpitations of the heart the drug is often markedly remedial, especially when the non-utility of all other agents has been proved. The late Dr. Christison, of London, especially extolled it; he employed it in a large number of instances with unequivocal effect, and by its aid succeeded in relieving a case of twenty-one years' standing.

Skin Diseases.—In eczema and other cutaneous disorders accompanied with intolerable itching, cannabis gives relief when local treatment does not, but it must be employed in a way to secure its full and prompt effect.

> In skin diseases associated with intense itching, particularly senile pruritus, where local applications fail to relieve, cannabis Indica is often used with great benefit; and, though there are rarely any untoward manifestations, it is best, perhaps, to give at first in small doses and then gradually increase. Mackenzie (La Sem. Méd., No. 14, '94; Univ. Med. Mag., Dec., '94).

Digestive Disorders. — In certain diseases of the stomach and digestive apparatus the drug is often available, and preferable to opium, in that it does not inhibit (but, instead, increases) appetite; does not interfere with the secretions of either pancreas or liver, and does not constipate or check renal secretion.

> Cannabis Indica is very valuable in the treatment of gastric neurosis and gastric dyspepsia. It allays painful sensation and improves appetite. It has no action on atony or dilatation of the stomach, but is of great service in promoting stomach digestion in cases of hyperchlorhydria; in anachlorhydria it acts feebly. Intestinal digestion is also improved by its use. On the whole, it may be considered as a true sedative of the stomach, and it lacks the disadvantages that accrue to opium, bismuth, potassium bromide, antipyrine, etc. Germain Sée (Bull. Gén. de Thér., July 29, '90).
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> In anorexia following exhaustive diseases—where there is repugnance and intolerance of food in almost every form that is not relieved by acids, nux vomica, and bitters—from 5 to 10 minims of tincture of cannabis, or ¼ to ½ grain of the solid extract, given thrice daily before meals, often brings back the appetite in two or three days. In dyspeptic diarrhœa also, and the first months of true tropical diarrhœas, it is often of great service. Tropical diarrhœa is primarily and essentially a disease of the liver, and mercury should be administered to medicate that organ, while the cannabis acts by diminishing the irritability and excessive peristalsis of the intestines. McConnell (Prac., London, Feb., '88).

Cephalalgia.—Many have praised the drug in the treatment of headache, even the severe forms attending cerebral growths, or where the cephalalgia is dependent on uræmic poisoning.

> It is almost a specific for that continuous form of headache which begins in the morning and lasts all day, the pain being generally dull and diffuse, but marked by occasional exacerbations. Mackenzie (La Sem. Méd., No. 14, '94).

Literature of '96 and '97.

Cannabis Indica is an excellent remedy for megrim, or sick headache, and it is somewhat surprising that it is not more frequently employed; the extract may be given in doses of from $^1/_3$ to ½ grain in the form of a pill. When the patient suffers constantly from headache, or is liable to an attack on the slightest provocation, a pill may be taken three times a day for many weeks

at a time without the slightest fear of the production of any untoward effect. Should the patient not speedily obtain relief, care must be taken to ascertain that the extract employed is physiologically active. Excellent results are often obtained by administration of pills containing 4 grains of cannabin tannate, one being given three times a day after meals. Murrell ("Manual of Phar. and Ther.," '96).

Rheumatism. — Here cannabis has been lauded for both its analgesic and curative effects, yet it is questionable if it deserves the encomiums bestowed; but it may tend to alleviate pain, and it also increases appetite and mental cheerfulness.

Respiratory Diseases.—It is also a capital sedative to the upper respiratory tract, and is a favorite factor in many cough-mixtures; Fothergill long ago commended its use in phthisis pulmonalis.

> It most perceptibly relieves the cough; it aids by its stimulating and exhilarating qualities, and supplies a place that cannot be filled by any other drug. Lees (Med. Rec., vol. xlix, '95).

Renal and Urinary Maladies.—It is also frequently recommended in Bright's disease where the urine is tinged with blood, and upheld as an almost specific for urethral spasm, for chordee, and the acute stage of gonorrhœa; also in gonorrhœa and vesical irritation, and in spermatorrhœa.

Literature of '96 and '97.

> Has been used in spasm of the bladder; and in gonorrhœa and chordee it has been found to be a most valuable remedy. Butler ("Text-book of Mat. Med., Ther., and Phar.," '96).
>
> Some authors accord cannabis Indica a higher reputation as a diuretic in acute and chronic Bright's disease, and consider that bloody urine is a special indication. It is said to relieve dysuria and strangury, and to be useful in retention of urine dependent on paralysis from spinal disease. It is very useful in menorrhagia or dysmennorrhœa. Has also been recommended in impotency. Ringer and Sainsbury ("Hand-book of Ther.," '97).

After all that is said, it must be admitted that few practitioners understand the real value of cannabis Indica, owing to the varied character of the preparations found in shops. The writer may say that constant use of the preparations manufactured by Squibb during more than a quarter of a century has proved their general uniformity and utility. The active principles, so called, offer no advantages, the resin churrus excepted, and are, if anything, more unreliable than the average solid and fluid extract. The majoon imported from India in foil wrappers is usually both uniform and palatable, but, unfortunately, difficult to procure.

G. Archie Stockwell,
(Central Staff).

CANTHARIDES.—The blister-beetle, or "Spanish fly," a coleopterous insect, also called lytta, is collected in Russia, Sicily, and Hungary, but is also found in Spain, France, Germany, and other parts of Europe. Representatives are found in various parts of the world, notably in the Levant and eastward, in Senegal, Southern and Central America, and in Chile. The insect is about an inch long, perhaps one-fourth inch broad, flattish, cylindrical, with filiform antennæ; it is black in upper part, with long wing-cases, and has large membranous, transparent, brownish wings; elsewhere of a shining, coppery-green hue. The powder is grayish- or blackish- brown, containing green, shining particles, with strong, disagreeable odor and acrid taste; is soluble in alcohol. Cantharides is often adulter-

ated, especially when powdered with other beetles, exhausted flies, and ground gum-resin euphorbium; but these can be detected, or at least surmised, by testing for the yield of cantharidine, which should not be less than 4 per cent.; it rarely exceeds 5.5 per cent.

Preparations and Doses.—Cantharides, powdered, $^1/_4$ to $^1/_2$ grain—not fit to be employed in crude form.

Cantharides cerate, for blisters only.

Cantharides cerate (made with alcoholic extract), external only.

Cantharides tincture (5 per cent.), 1 to 30 minims.

Cantharides vinegar, external only.

Cantharidine, not employed.

Cantharidate of cocaine, $^1/_{300}$ to $^1/_{100}$ grain.

Cantharidate of potassium, $^1/_{400}$ to $^1/_{200}$ grain; hypodermically only.

Cantharidal collodion.

Cantharidal liniment.

Cantharidal oil, external only.

Cantharidal ointment.

Cantharidal paper (blister-paper).

Cantharidal plaster with pitch.

Cantharidal warming plaster.

The powder of cantharides is too acrid and irritating to be employed except in very minute doses or well covered by other substance, and, even then, preferably in capsules. Its chief employment is as the component part of cerates, liniments, ointments, and other epispastic galenicals.

CANTHARIDES CERATE, "blister-plaster," or "flying blister," is made by mixing 96 grains of finely-powdered "flies," 60 grains of yellow wax, 68 grains of prepared suet, 24 grains of resin, and 48 grains of lard, the whole, when thoroughly incorporated, being spread on a suitable piece of sheep-skin or adhesive plaster.

The "WARMING" PLASTERS are of two kinds. One is obtained by adding, to a strong infusion of 4 ounces of cantharides, 4 ounces each of oil of nutmeg, yellow wax, and pure resin; and then incorporating with 3 $^1/_4$ pounds of resin-plaster and 2 pounds of soap-plaster, the last two being previously heated; it should have a decidedly-yellow hue. The other, also termed cantharidal pitch-plaster, is composed of Barbadoes pitch, to which ordinary cantharidal cerate is added to the amount of 8 per cent.

CANTHARIDAL, OR "BLISTERING," COLLODION is a thick liquid formed by adding 1 ounce of pyroxylin (gun-cotton) to 20 ounces of the blistering liquid known as cantharidal liniment; this latter is obtained by macerating for twenty-four hours 8 ounces of cantharides in 4 ounces of acetic acid, then percolating the mixture with a pint of ether until 20 ounces are obtained. Another liniment is composed of 15 parts of cantharides in sufficient turpentine to make 100 parts.

CANTHARIDAL, BLISTERING-, OR EPISPASTIC PAPER is merely a good wax- or paraffin- paper coated on one side with a mixture of 4 ounces of white wax, 1 $^1/_2$ ounces of spermaceti, 2 ounces of olive-oil, 6 drachms of resin, 8 drachms of cantharides, and 6 ounces of water,—the whole heated together,—then adding 2 drachms of Canada balsam after rejecting the watery liquid.

By digesting 3 parts of cantharides in 10 parts of olive-oil for ten hours over a water-bath, CANTHARIDAL OIL is obtained.

CANTHARIDES OINTMENT is a mixture of 1 ounce of the flies with an equal amount of yellow wax and 6 ounces of olive-, cotton-seed, or peanut- oil.

The "VINEGAR" may be prepared by digesting, at 200° F., and subsequent

percolation, 2 ounces of cantharides, 18 ounces of acetic acid, and 2 ounces of glacial acetic acid.

CANTHARIDINE, or cantharidal camphor, is found in glistening rectangular prisms, which melt at 218°; heated higher it gives off a heavy, white, very irritating vapor, condensing unaltered to crystals. It is easily soluble in acetone, sulphuric acid, and glacial acetic acid, less so in chloroform (1 to 80), very little in 90-per-cent. alcohol, 1 to 500 in petroleum ether, and 1 to 5000 in water; the aqueous solution, though practically tasteless, is by no means devoid of vesicatory power even in the minutest quantities. Cantharidine is also soluble in fatty oils and gives an acid reaction to very sensitive litmus-paper; it volatilizes at 100°. It likewise combines readily with alkalies to form soluble salts. If nitric acid is added to cantharidinate of sodium, crystals of cantharidine are at once precipitated.

The foregoing paragraph sufficiently explains the formation of cantharidate of potassium, which, however, seems only to have had an ephemeral existence.

Cantharidate of cocaine is a mixture of cantharidate of sodium and cocaine muriate, and occurs as a white, inodorous, amorphous powder with a sharp taste, readily soluble in alcohol, ether, petroleum spirit, and hot water. Its uses are the same as those of the potassium salt.

Physiological Action.—All species of cantharides are powerfully irritant when applied to the skin, and likewise vesicant, these two properties depending upon the cantharidine. Internally the drug can be given properly only in the form of tincture, for obvious reasons (see POISONING), though the powder is sometimes, though rarely, mistakenly employed; and even the tincture should be employed only in connection with copious diluents and demulcents. Suitably administered, the tincture is a stimulant diuretic, and it appears also to exert a specific influence upon the mucous membrane of the genito-urinary system, particularly the neck of the bladder. In larger doses it is highly irritant, and it is not an uncommon accident for sufficient of the drug to be absorbed during applications to the skin to cause great irritation of the kidneys, as evidenced by painful micturition and bloody urine.

Literature of '96 and '97.

The inflammation produced by cantharides begins in the glomeruli and not in the straight tubes. The first condition of the kidneys noticed after the administration of the drug is extravasation of leucocytes into the glomeruli and an exudation of a fibrous matrix. This is followed by filling of the glomeruli and the proximate tubules with a granular fluid, after which comes swelling of the cells of the capsule. Next in order swelling of the cells of the collecting tubes and of the whole urinary tubule is observed; and in the last stage multiplication of the cells of the straight collecting tubes which are thrown off so that their lumen becomes filled with exuded cells. Murrell, Lond. ("Manual of Mat. Med. and Therap.," '96).

Lahousse finds that cantharides affects simultaneously the Malpighian bodies, the renal tubules, and the matrix of the kidney. The Malpighian vessels are greatly congested; albumin, leucocytes, and a few red corpuscles escape; the epithelium covering the vessels lining the capsule swell and desquamate; the endothelium of the vessels swells and may choke their lumen; the tubule-cells swell, become granular, and die. The tubules contain hæmoglobin in the form of brilliant-red homogeneous cylinders. Leucocytes escape into the matrix. Other observers hold that the Malpighian bodies are alone, or chiefly, affected. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Cantharidal Poisoning.—The drug in non-medicinal doses is an acrid, corroding poison, the chief symptoms being a burning sensation in the throat, violent pains in stomach and bowels, nausea, vomiting, and purging,—the dejections being frequently bloody and purulent,—great heat and irritation of the urinary organs, sometimes accompanied by painful erethism, and in the male painful priapism, quick and hard pulse, laborious breathing, convulsions, tetanus, delirium, and syncope. The morbid appearances are principally inflammation and erosion of the stomach. If the flies or powder have been ingested, characteristic *débris* will be found adhering to the mucous coat of the stomach and intestines, and, if recent, mixed with the contents of the *prima viæ* generally; powder of cantharides has been identified in the stomach nine months after death; there are also discoverable the marks of violent inflammation throughout the urinary organs; but such are usually most prominent when the poisoning is not fatal. The kidneys are frequently gorged with blood, as is the brain.

Treatment of Cantharidal Poisoning.—There is no known antidote for this drug, and all toxic cases require to be treated in consonance with the indications afforded by each individual case; it frequently can be little beside palliative. The promotion of free vomiting is generally imperative, further fostering by means of warm demulcents and diluents; diluents are in order even after emesis has accomplished all possible. Bland oils have been suggested, but these are dangerous, since they are apt to separate the cantharidine, which is very soluble therein, and thereby enhance and hasten toxicity. Opium, even chloroform by inhalation, is sometimes demanded to allay the excruciating suffering or to control convulsions. Opium enemas and frictions also will find place. Camphor often alleviates the most distressing symptoms, and bromides may be required. The smallest amount of tincture known to have induced fatality is 1 ounce; of the powder, 48 grains.

> Case of cystitis caused by the use of cantharides as a blister. The symptoms were of considerable severity. Monobromated camphor was given both by the mouth and by enema; but no relief was obtained. The condition, however, yielded promptly to the influence of cocaine. Albarran (Lancet, Lond., Dec. 12, '92).

Therapeutics.—The internal administration of cantharides finds less favor than it did half a century back, doubtless because of the many accidents that have followed its employment. Some years ago the tincture was lauded as a powerful depressant, contrastimulant, and antiphlogistic, and advised to be used in acute inflammation, but even the Italian physicians, who were the strongest supporters of the drug in this connection, soon abandoned it for other and more safe medicaments. At present it finds its chief employment in the management of genito-urinary disorders, and, among French physicians, in diseases of the skin and scalp. The late Dewees considered the tincture in doses of 10 minims, gradually increased to twice or thrice this amount, to be an absolute specific in amenorrhœa; but how he avoided symptoms of strangury, when administering the larger doses, considering the potent nature of the remedy, is something of a mystery.

> When given by the mouth the tincture is used as a uterine stimulant to affect the uterine mucous membrane and relieve amenorrhœa in cases where atony and depression are the causes of suppression. Hare ("Prac. Therap.," '94).

It is a very decided uterine stimulant and is much used as an ingredient of emmenagogue mixtures. From 3 to 5 drops of the tincture may be given three times daily; if no unpleasant symptoms arise, the dose may be cautiously increased to 6 drops, the production of strangury being, of course, sedulously avoided. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Cantharides in doses of 1 grain, or 4 to 10 minims of the tincture, is employed as an emmenagogue, but acts injuriously upon the kidneys, and is better not used. Roth ("Mod. Mat. Med.," '95).

Literature of '90 and '97.

Amenorrhœa, occurring in debilitated women, will often be benefited by cantharides. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Incontinence of Urine. — Where this depends upon an atonic state of the bladder, the tincture may often be given with excellent effect; it appears to act locally, stimulating the parts and restoring a healthy tone to the bladder.

It is valuable in bladder cases which are characterized by want of power in the sphincter, especially in women. Whitla ("Pharm., Mat. Med., and Therap.," '92).

In minute doses cantharides relieves vesical irritation, also the enuresis of women occurring during the day while up and around, the condition being a partial paralysis of the vesical sphincter. Webster ("Dynam. Therap.," '93).

It is of value in incontinence of urine of a minor degree, as that occurring in some elderly or nervous females when coughing, sneezing, or laughing, and will often give relief after many years of suffering. Hare ("Prac. Therap.," '94).

Literature of '96 and '97.

Small doses of cantharides may be relied upon to cure the slight incontinence of urine which, with women, is frequently associated with paroxysmal cough. Half a drachm is prescribed with 4 ounces of water, and of this a teaspoonful is taken hourly. It rarely fails to effect a cure in twenty-four hours. Murrell, Lond. ("Manual of Mat. Med. and Therap.," '96).

Women, especially middle-aged women, often suffer from a frequent desire to pass water, or an inability to hold it long; sometimes this occurs only in the day on moving about. In these cases micturition may cause no pain, neither is there likely to be any straining, sneezing, or coughing. Sometimes both set of symptoms are present, due apparently to weakness of the sphincter of the bladder. One or two drops of tincture of cantharides, three or four times a day, will, in many cases, afford great relief to these troubles, and sometimes cure them with astonishing rapidity, even when the symptoms have lasted for months or years. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Urinary Suppression. — The drug has also been recommended as a remedy for suppression of urine, but on what physiological grounds it is difficult to imagine; the evidence afforded is too flimsy to be worthy of consideration from even an empirical stand-point.

As an Aphrodisiac.—In the treatment of impotence the drug has, especially of late years, received its greatest employment, and the affirmative evidence is not without weight, though many have experienced nothing but failure from its use. Sloughing of the penis may occur from the employment of cantharides, even in what are deemed safe medicinal doses.

Spanish flies in minute doses exert an influence on the reproductive apparatus, stimulating the sexual functions, producing erotic excitement. Webster ("Dynam. Therap.," '93).

In impotence depending upon sexual excesses, 10 to 15 drops of the tincture with full doses of tincture of chloride of iron and nux vomica, will often relieve and enable the patient to beget children. The drug has no true aphrodisiac influence except in toxic dose. Hare ("Prac. Therap.," '94).

Internally employed, rarely, in doses of 4 to 10 drops three times a day in a mucilaginous mixture for impotence; but must be used carefully because of the danger of causing albuminuria. Roth ("Mod. Mat. Med.," '95).

EMMENAGOGUE AND ABORTIFACIENT.—Both these properties are claimed for cantharides, and it is generally admitted that the claims possess a measure of truth, but also that its employment for either purpose is little, if any, less than criminal. Sloughing of the labia is a frequent result from this use of the drug.

Cantharides has been used for the purpose of procuring abortion, and it possesses emmenagogue properties. Farquharson ("Therap. and Mat. Med.," '89).

The drug is a very decided uterine stimulant, and is much used as an ingredient of emmenagogue mixtures. From 3 to 5 drops of the tincture may be given three times daily; if no unpleasant symptoms arise, the dose may be cautiously increased to 6 drops, the production of strangury being, of course, sedulously avoided. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Spanish fly may be given internally as an emmenagogue in dose of 1 grain, or an equivalent, of the tincture, but it is better not employed because of its injurious effect upon the kidneys. Roth ("Mod. Mat. Med.," '95).

URETHRAL, PROSTATIC, AND CYSTIC MALADIES.—The drug has been employed in all these conditions with, at times, very apparent benefit; but that its application is by no means universal is evidenced by the fact that it frequently fails. The conditions when it is likely to prove of value, therefore, require to be carefully considered and studied out. It certainly is of no value, of itself, in syphilis, but given in conjunction with mercury salts it materially enhances their activity.

Cantharides is valuable in bladder cases which are characterized by want of power in the sphincter, and has been recommended in gleet. Whitla ("Pharm., Mat. Med., and Therap.," '92).

In cystitis it is very rarely indicated, but may be cautiously employed in very chronic cases. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Literature of '96 and '97.

After its separation by the kidneys cantharides acts as an irritant to the urinary tract, and it may be employed for this action in cystitis, in gonorrhœa, and in gleet. One drop of the tincture, though 5 are sometimes required, should be given three or four times a day; this treatment is particularly useful in cases where there is a frequent desire to make water, accompanied by great pain in the prostate gland and along the urethra, while at other times severe twinges of pain are felt in the same parts. The urine, under these circumstances, may be healthy, or it may contain an excess of mucus or even a small amount of pus. A drop of the tincture, three times daily, will, in the majority of instances, abate or remove chordee. Ringer and Sainsbury ("Hand-book of Therap.," '97).

DISEASES OF KIDNEY.—*As a Diuretic.*—A half-century ago, on the Continent of Europe, tincture of cantharides was largely employed in albuminuria, beginning with small doses and gradually increasing to 60 minims, and it is authoritatively declared that this procedure was often attended with decided benefit; the caution is given, however, that it is not always successful, and that, moreover, it is a dangerous remedy in the hands of the inexperienced. In granular disease of the kidney, too, the drug has been most favorably mentioned, particularly by Copland, the author of a famous "Dictionary of Practical Medicine."

The drug is powerfully diuretic under certain conditions, but is not a desirable remedy to exhibit by itself; it is a most valuable adjunct to digitalis, however, when this latter remedy is employed for the express purpose of promoting diuresis.

Though employed as a diuretic, the drug acts injuriously upon the kidneys, and there is always danger of inducing albuminuria; it is better to forego its use entirely. Roth ("Mod. Mat. Med.," '95).

Scurvy; Chronic Whooping-cough.—These are two more maladies for which the drug has been employed, but with no apparent success; and in whooping-cough it has never appeared to be of benefit except when combined with cinchona and opium.

Skin and Scalp Diseases.—In lepra, eczema, and psoriasis cantharides still is in considerable repute, but does not secure the same degree of form that accrued to it in the latter part of the last, and early part of the present, century. It is advised that the tincture be given in 3- to 5-drop doses, three times daily, the amount to be increased by 5 drops every six or eight days, until the limit of tolerance has been reached.

Literature of '96 and '97.

Liniments and lotions containing tincture of cantharides are among the best means of curing alopecia. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

The cantharidal preparations are used applied to bald patches, to promote the growth of hair in functional alopecia and to destroy the tinea of ringworm; they are, too, applied to the diseased skin prior to the application of other tineacides. Dupuytren's formula, used for the foregoing purposes, is made by combining a tincture of extra strength (1 drachm of cantharides to 1 ounce of alcohol) with 9 parts of lead. Biddle ("Mat. Med. and Therap.," '96).

Ear Diseases.—In deafness depending upon a thickened state of the drum-membrane, and where there is much irritation of the external meatus, many practitioners in the past believed they had secured great benefit by applying a strong cantharidal ointment—1 to 2—below and behind the ear thrice daily.

In tinnitus aurium, cause unknown, the application of cantharidal plaster or collodion finds favor with some; in acute catarrh of the middle ear it is also used occasionally, and also in otitis media; but it cannot be said that any good results follow its use. It is applied over the mastoid process. Webster ("Dynam. Therap.," '93).

Nervous and Spinal Disorders.—In epilepsy cantharides has been favorably mentioned, and was at one time held in considerable esteem by the older practitioners, but it does not appear to possess any special virtues in this direction. It has, however, sometimes seemed to be of marked benefit in paraplegia, but only when it exercised a diuretic effect. Also it is often available when there is serous effusion into the vertebral canal, as in spinal dropsy, and both its internal administration and application externally in the form of blistering cerate tends to promote absorption of the effused fluid.

Cantharides is occasionally prescribed in chronic diseases of the spine. Farquharson ("Therap. and Mat. Med.," '89).

Literature of '96 and '97.

In certain diseases of the spinal cord and of the brain, cantharidal blisters applied to the nape of the neck or along the course of the cord, a little to one side of the vertebræ, will often favorably influence the course of the disease. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Respiratory, Cardiac, and Dropsical Maladies.—Cantharides is occasionally administered internally with benefit in passive dropsies with a view of stimulating the action of the kidneys, but it is inadmissible in sthenic or acute cases; it should be administered in conjunction with some other diuretic, how-

ever, such as a decoction of broom, infusion of digitalis, or sweet spirit of nitre. In the form of blister the cerate is also useful in these maladies, as well as in pericarditis, pleuritis, pneumonia, and more rarely phthisis.

Within a few years the cantharidate of potassium has been employed as a remedy for pulmonary and laryngeal tuberculosis, on the strength of some experiments undertaken by Liebreich; also the cantharidate of cocaine. Liebreich's theory is that the inflammatory processes set up by the cantharidin produce a transudation of sanguineous microbicidal serum.

> Two experiments were made on rabbits with cantharidate of potassium, which was injected into the ears. The effect was negative so far as the production of serous exudation was concerned, but the animals subsequently died from chronic cantharidin poisoning. Autopsy revealed no serous changes. The conclusion to be drawn is that Liebreich's theory is incorrect. Coen (Archives de Méd. Exper. et d'Anat. Path., May, '91).
>
> The chief points to be decided are whether cantharidinates have any action on diseased, particularly tuberculous, tissues, and, if so, whether this effect is obtained before any disturbance is produced in other organs, such as the kidneys. The cantharidinate gives rise to an increased exudation from the capillaries; hence its beneficial action; but there is no hyperæmia. Advanced tuberculosis, however, should be treated with extreme caution, for the kidneys are often fattily degenerated. Improvement has been recorded in other than tubercular processes, —*e.g.*, in chronic laryngitis. Any local application of a cantharidinate is not rational, as it only produces irritation. In hundreds of injections made, there has been no more danger to the patient than from the use of mercury or arsenic. Liebreich (Therap. Monat., June, '92).

Recently, Liebreich and others have recommended the subcutaneous use of cantharidin in combination with alkalies in the treatment of tuberculosis. While the value of this method is still undetermined, the accumulated testimony gives little encouragement for its employment in this affection. In pneumonia, pericarditis, etc., cantharides is a most useful vesicant.

> Cantharidinates of potassium and of cocaine have of late been applied, hypodermically injected, in the treatment of tuberculosis, but their value has not yet been accurately determined. The results so far obtained have not been very satisfactory. Cerna ("Notes on the Newer Rem.," '95).

Blisters.—These are applied to establish a degree of inflammation or irritation on the surface of the body, and thus to substitute a mild and easily managed disease for an internal and intractable one, on the principle that two sets of inflammation cannot be carried on at the same time: a theory that admits of some question; to stimulate the absorbents and thus cause the removal of effused fluids; to act as derivatives; to stimulate the whole system, and raise the vigor of the circulation. A few rules find universal application as regards the use of these agents, viz.: Never apply a blister at the beginning of inflammation,—never until the acute stage has been subdued by other means. Never apply where the skin is thin or tender nor over a bony prominence, as great irritation will result, and the healing will be slow and difficult. In many instances, as in acute laryngitis, it is not advisable to apply a blister directly over the seat of the disease, as it sometimes aggravates the symptoms; indeed, a blister is often more efficacious if applied at a remote point, as to the heel in sciatica or lumbago. As a rule, it is not advisable to allow a blister to remain on the part to which it is applied more than two or three hours,—only until it has

produced considerable redness, when the process may be completed by soft, warm poultices. A blister has been known to produce abortion when applied to the neck or chest of a pregnant woman. Blisters applied to a scorbutic person are apt to induce ulceration and gangrene; and the same is, in a measure, true as regards this application to children, who, as a rule, bear vesicants badly. Finally, the danger of absorption of cantharides from cantharidal vesicants, sufficient to induce untoward phenomena, and even toxicity, should always be considered. Violent strangury has resulted in some instances from the application of a blister to the penis with a view of preventing masturbation.

G. Archie Stockwell,
(Central Staff).

CAPILLARY BRONCHITIS. See Pneumonia, Catarrhal.

CARBOLIC ACID. See Phenic Acid.

CARBUNCLE. See Anthrax.

CARCINOMA. See Tumors.

CARDIAC ANEURISM. See Aneurism.

CARTILAGINOUS TUMORS. See Tumors; Enchondroma.

CASTOR-OIL. See Ricini.

CATALEPSY.—From Gr., *κατάληψις*, seizure.

Definition.—Catalepsy is not a distinct disease, but a symptom of a disordered condition of the highest nerve-centres: the cerebral cortex. During the attacks, which are intermittent, the nervous system, especially the lower, is in an excitable state; the higher centres have lost control over the lower; the face at times is as passive and expressionless as that of a marble statue, while in some cases the face seems to indicate mental agitation; there is impairment, or apparent loss, of consciousness, volition, and sensation; the patient lies, sits, or stands with muscles in a state of tonic or rigid immobility, and if the head or limbs are placed by an attendant in awkward, or what are usually uncomfortable, positions, they may remain so for an indefinite period, minutes or hours, without any apparent voluntary effort or evidence of fatigue on the part of the patient.

All these manifestations represent but a series of nervous phenomena indicating a deranged condition of the normal functioning power of the general nervous system; we are therefore prepared to learn that in a few cases it may be the only obtrusive evidence of disease; that it may occur associated with hysteria, or that it probably may be one of the manifestations of this affection; that it may be an epiphenomenon of certain organic diseases of the brain, such as abscess, tumor, softening, meningitis, hæmorrhage, etc.; that it may be found in epilepsy, insanity, chorea, or, in fact, in almost any condition of the nervous system in which the inhibitory or controlling power of the higher nerve-centres over the lower is greatly impaired or lost during the attacks.

Varieties.—As to the varying conditions under which the phenomena may be manifested, with modifications of the symptoms in different cases, those who have regarded catalepsy as a distinct disease, *sui generis*, have spoken of "true" and "false" catalepsy: *catalepsia vera* and *catalepsia spuria*. With most of these writers there is but one form of

catalepsy: that in which the limbs or any flexible portions of the body present a condition likened to a figure of soft or easily-molded wax (so-called *flexibilitas cerea*), in which the parts, without any apparent voluntary effort on the part of the patient, remain for an indefinite time in the positions in which they may be placed.

My individual impression is that catalepsy, unassociated with organic disease, denotes an hysterical condition, and is then one of the numerous manifestations of hysteria or an affection closely allied to it. In some cases the cataleptic phenomena may be the only evidence of disease, but this is so rare that some observers have never met with an example.

> It may probably be placed between epilepsy and hysteria in the scale of maladies, but nearer the latter than the former, and, as regards the nature of its chief feature, it may be regarded as essentially one of the motor. But there is also distinct interference with the intellectual processes, and interruption of the connection between the will and the motor centres. W. R. Gowers ("Quain's Dic. of Med.," vol. i, p. 285).

> [It is no more surprising that catalepsy should occur from organic disease of the brain than that hysteria should manifest itself under similar circumstances, and, in some instances, become so prominent as to lead the unwary observer to mistake a tumor or some other lesion for the functional disturbance. Indeed, it seems to me that this is another reason for regarding catalepsy as one of the manifestations of hysteria or its twin-sister. In Colorado hysteria in its exaggerated forms is almost unknown. During a residence of fourteen years in this State I have not met with a single case of catalepsy in which the cataleptic phenomena were prominent or constituted the sole evidence of the nervous disturbance. During my residence here my practice has been almost entirely limited to the diseases of the nervous system (mental and physical), and I have seen cases from nearly every portion of the State, and many from the adjoining States and territories. If other observers shall find that so-called true catalepsy is only found in places favorable for the development of hysteria in its most pronounced type, it will show, at least, that the phenomena of the former are closely associated with those of the latter, if, indeed, they are not a part of them. Further, the course, duration, prognosis, and treatment of catalepsy are almost identical with those of hysteria. J. T. ESKRIDGE.]

I shall first endeavor to give a description of the cataleptic phenomena in cases in which they occur as the principal or only symptoms of the nervous disorder, then as they are found associated with other, and often graver, nervous derangements.

Symptoms.—The symptoms of catalepsy are not easily described, as the phenomena observed are seen under so many different conditions. In a very few cases the cataleptic phenomena are the only obtrusive evidences at the time of the attack of a disordered state of the nervous system; in a second class the symptoms of hysteria are so pronounced that it is difficult to determine which is the real affection; in a third the cataleptic phenomena form a part of a graver disease, such as insanity, epilepsy, or organic trouble of the brain; in a fourth the nervous symptoms are the results of certain poisons or toxæmic states; and finally in a fifth the peculiar nervous disturbances are a part of the phenomena witnessed in a state of hypnosis which has been introduced by a method that greatly agitates and excites the higher nerve-centres. I shall first try to give a description of catalepsy as free from complications as possible, then will follow references to cataleptic phenomena as met with in association with other nervous disorders.

Catalepsy is essentially a paroxysmal or intermittent affection. For its development in its typical form it probably always requires on the part of the subject a certain predisposition, an unstable and excitable nervous condition, a tendency to hysterical manifestations, most prominent among which is hypersensitiveness of some of the special senses. The paroxysms vary greatly in their severity and duration. The pronounced symptoms usually come on suddenly, but these are often preceded by headache, slight hysterical manifestations, giddiness, gastric symptoms, or hiccough. The special symptoms are ushered in by all or part of the voluntary muscles suddenly becoming rigid, the limbs remaining in the positions in which they were arrested by the onset of the attack.

In some cases the arm stops in the act of carrying a cup to the mouth; the latter remains open and the whole body assumes a fixed position, as if petrified. At first the muscles are quite rigid and resist strong passive motion; but soon the rigidity is followed by a soft, wax-like state of the muscles. The limbs may then be placed in various positions by moderate passive motion, and in these they will remain for several minutes, or even for hours in some cases. If an arm or a leg is placed at a right angle with the body, with no support except that given by the muscles in a state of increased tension, it would be maintained in this uncomfortable position for a considerable length of time; but after awhile the limb from force of gravity begins gradually to descend. Two important observations may be made at this stage of the attack that have considerable diagnostic value. One is that the patient's features and respiration show no evidence of fatigue or voluntary effort, and the other is that if a weight of a few pounds is suspended to the limb, or passive motion is exerted to overcome the tension of the muscles that hold the limb in its position, the member gradually descends, without any extra effort being exerted to keep it from falling. Consciousness is always impaired, and sometimes apparently completely lost, from the first. The degree of disturbed consciousness varies in different cases. In some cases it seems to be completely abolished.

> [I think Dr. C. K. Mills is right in cautioning against haste in believing that unconsciousness is complete in a given case. J. T. ESKRIDGE.]

In a few cases in which the cataleptic condition of the muscles is well marked the patient makes no attempt to answer questions or to move when the skin is irritated, because volition is in abeyance; but the patient may know everything that goes on around her. The pulse, temperature and respiration are slightly changed. The pulse is slow or normal; the temperature is usually a little subnormal; sometimes it is one or several degrees below the normal; respiration is quiet, shallow, and sometimes almost imperceptible. The face is pale, the eyes wide open and looking horizontally forward. Sometimes the lids are partially or gently closed. The pupils are dilated, often react to light slowly, but in some cases they show no response. The fundi and optic nerves have been found anæmic, according to W. A. Hammond. The features frequently present a blank or placid appearance, but in some cases they show evidences of mental agitation. The skin is often very cool and pale, especially if the paroxysm is prolonged; this with the almost imperceptible respiration and expressionless features, open eyes, and dilated pupils—give the patient the appearance of death, for

which catalepsy is said to have been mistaken.

Cutaneous sensibility is often abolished; in some cases it is only impaired; rarely a condition of hyperæsthesia has been observed. The cornea, conjunctiva, and pharynx may present no evidence of sensation, or they may retain partial sensibility; so that the eyelids will close when the eyeball is touched, and the reflex of the pharynx may be obtained. In some cases the power of deglutition is said to have been lost, but, more commonly, when the food is placed on the posterior portion of the tongue it will be swallowed. The deep reflexes are usually lessened; they are rarely increased, and in some cases absent. They may be present on one side and absent on the other, although the wax-like condition of the muscles is bilateral. The functions of the special senses seem to be impaired or abolished, although in some cases it is possible to elicit a response from the patient by stimulating the organ of hearing, and occasionally that of sight. The electrical reactions of the muscles and nerves have been found normal, lessened, and in exceptional cases increased.

The paroxysms, even if prolonged, do not remain at their height for a great length of time. They may last only a few minutes, hours, or in rare cases days. In the prolonged attacks there are usually intermissions or remissions, during which the patient completely or partially arouses for a few minutes and then relapses. Hammond says the paroxysm generally disappears as abruptly as it began. "A few deep inspirations are taken, the eyes are opened, or lose their fixedness, the muscles relax, and consciousness is restored, but no knowledge of what has occurred is retained." It is probable that in the majority of cases there is gradual restoration to consciousness, the patient remaining bewildered and stupid and the muscles more or less rigid during the emergence from the cataleptic state. Eulenburg states that in some cases the attacks may disappear quite suddenly. "The patients recover at once full consciousness and the normal use of their muscles, take up their employment which had been interrupted, continue the sentence previously commenced, and conduct themselves as if not the slightest thing had intervened."

> [I have seen a few such cases, but I have looked upon them as epileptic in character, and of the variety known as *petit mal*. The subsequent course of two of these has shown that my apprehensions had been well founded. J. T. Eskridge.]

Continuing, Eulenburg says: "Much more frequently the patient's recovery is only slow and gradual; they are at first somewhat stupid, as if awakening from an unusually sound sleep. Sensibility is still diminished, the power of the will weakened; a certain amount of the stiffness of the muscles still remains for some time, which renders motion difficult and slow."

The frequency of paroxysms varies greatly in different cases. One or more attacks may occur in the twenty-four hours; they may be repeated every few days, weeks, or months. Just as we find in epilepsy, so we not infrequently observe in catalepsy, that if the paroxysms return every few weeks or months several attacks may occur at these times within a period of a few days. In rare instances only a few paroxysms are observed during life-time, separated from each other by a period of years, as we find in some cases of epilepsy. In still more exceptional cases only one attack occurs.

During the interval of the attacks

little or nothing may be observed to distinguish the subject from a normal person. More commonly, especially when the paroxysms occur frequently and with any regularity, the patient is irritable, nervous, hysterical, and complains of lassitude, and sometimes of dizziness and headache, during the interval of the attacks.

Complications and Concomitant Disorders.—The complications, or, better, the disordered conditions of the nervous system which the phenomena of catalepsy may complicate, are numerous.

Hysteria and catalepsy are so nearly alike in many of their phases that it is not always possible to draw any distinct line between the two affections. The cases complicated by hysteria may present one of the following conditions: All the phenomena of catalepsy may be present, but in addition thereto there may be numerous and pronounced symptoms of hysteria, both during the attacks and in the intervals; or the seizures may be so typically hysterical that were it not for the symptoms of catalepsy at the time of the paroxysms the case would be termed one of pure hysteria. In fact it is such, with the phenomena of catalepsy added. Such cases are usually chronic, little influenced by treatment, and the patient during the intervals between the paroxysms may present all kinds of hysterical symptoms, even convulsions.

What has been said in regard to catalepsy complicated by hysteria applies in no small degree when this affection is associated with trance, ecstacy, somnambulism, and certain forms of somnolency. These are all nearly allied to hysteria when they are due to a functional disturbance of the nervous system.

Catalepsy often occurs in association with epilepsy, chorea, insanity, or organic diseases of the brain. In *chorea* cataleptic phenomena have been met with, and in some instances these have been quite pronounced with states of automatic action resembling certain phases met with in hypnotism especially in children. *Epilepsy* may be associated with cataleptic symptoms, but we should be careful in the study of these cases to determine whether the latter are not evidence of true epilepsy. In those cases of supposed catalepsy in which consciousness is suddenly recovered and the patient immediately returns to the normal condition, finishes the employment which had been begun before the attack, or continues a sentence that had been interrupted, and acts as though nothing had happened, it is quite probable that the symptoms are epileptic in character.

[Dr. Thomas King Chambers says: "Catalepsy is sometimes very brief and sudden. I have a young lady now under my care, for non-assimilative indigestion, of whom I received the following accounts from a mother of more than ordinary intelligence and power of observation. She said that her daughter was fond of reading aloud, and that sometimes in the middle of a sentence the voice was suddenly stopped, and a peculiar stiffness of the whole body would come on and fix the limbs immovably for several minutes. Then it would relax, and the reading would be continued at the very word it stopped at, the patient being quite unconscious that a parenthesis had been snipped out of her sentence, or that anything strange had happened. She grew much better under tonic and restorative treatment, and gradually ceased to have these singular attacks; but after about a month's interval, as she was one evening engaged in playing a round game of cards, she suddenly went off into a regular epileptic fit, which was followed by sleep, and she did not recover consciousness till the next morning. This fit could be accounted for by certain errors in digestion, and she has had no recurrence of

it, or of the catalepsy, though four months have passed over. So I hope it was epilepsy of an intercurrent or curable sort." One feels that this must have been a vain hope, and, had the history been subsequently continued for a period of a year or more, it would probably have shown that the case was one of epilepsy, and not of the "curable sort." The next case that he reports is more serious. "But sometimes the epilepsy preceded by catalepsy is of a more serious sort. I remember a much-respected lecturer in this metropolis in whom the *petit mal* of epilepsy assumed this form. He used to be attacked sometimes in the middle of a sentence, with his hand wielded in demonstration before his class. He would remain perfectly stiff for a minute or so, with mouth open and arm extended, and then resume his sentence just where he had dropped it quite unconscious that anything had happened. After a time the seizures assumed the more usual and more fatal form." (Reynolds's "System of Med.," [Hartshorne], vol. i, pp. 654-55). I have seen several cases of epilepsy, especially in children, the first symptoms of which simulated those of catalepsy. J. T. ESKRIDGE.]

Literature of '96 and '97.

Cataleptic symptoms in eight rachitics aged from eighteen months to three and one-half years. The phenomena were manifested by the persistence of the position given to a limb. When the leg was raised, for instance, it was maintained in this position for a long time, often as long as fifteen to twenty minutes, in one case even as long as forty minutes, and then falling very slowly. If the position of the limb or parts of it was changed, even to a very uncomfortable attitude, the immobility would be maintained for an equal period of time. This phenomenon was more constant and distinct in the leg than in the arm. There was no tremor in the limb; during this cataleptic state the reflex excitability seemed diminished. Epstein (Revue Men. des Mal. de l'Enfance, Jan., '97).

Insanity, especially stuporous insanity, the graver forms of melancholia, catatonia (of Kahlbaum), and paretic dementia may be associated with cataleptic conditions. These are most typically seen and most frequently met with in catatonia, in which increased motor tension is one of the diagnostic symptoms of the disease. In the other forms of insanity the cataleptic phenomena seem to be accidental. Their presence in any form of insanity indicates profound nutritional changes, and therefore adds gravity to the prognosis. Cases of *organic disease of the brain* only infrequently present symptoms somewhat similar to catalepsy. Cases of tumor, abscess, hæmorrhage, softening, traumatic injuries of the brain, and of meningitis, especially of the tubercular variety, have presented temporary symptoms of catalepsy.

It is important to bear in mind that organic disease of the brain may be the cause of cataleptic phenomena, lest an organic lesion should be mistaken for an affection that is functional in its nature.

Chloroform or ether narcosis; opium poisoning in extremely rare instances; and certain toxæmic states, probably from autoinfection, may cause conditions simulating catalepsy. It is so rarely that one meets with a case of opium poisoning in which convulsions or cataleptic phenomena are present that were the physician not on his guard there would be great danger of mistaking the case for a lesion of the pons, or some condition other than that caused by a lethal dose of opium.

Hypnosis and *catalepsy* need no discussion here, further than the statement that many of the cases of catalepsy reported as occurring in very young children of two or three years of age present symptoms somewhat similar to those seen in hypnotized subjects, especially

in those in which the hypnosis has been induced by the Charcot method, such as having the subject stare at a bright object, held in such a position as to cause the eyes to converge and look upward. Unilateral cataleptic phenomena are often seen in hypnotic subjects. It may often be developed at the will of the hypnotist.

Diagnosis.—"The peculiar rigidity of catalepsy is characteristic, invariable, and renders the diagnosis a simple matter," says Gowers. In the last edition of his great work on "Diseases of the Nervous System" the writer states that "the diagnosis of catalepsy presents no difficulty." That the peculiar rigidity and wax-like flexibility must be present before we are justified in making a diagnosis of true catalepsy, I think, will be accepted by almost every clinician, but that these conditions may be present as prominent symptoms in certain grave diseases of the central nervous system, and possibly mislead the physician in mistaking the cataleptic phenomena for the real disease, must also be borne in mind. In the face of the possibility of the occurrence of such an error, it seems to me that it is the first duty of the physician in the diagnosis of catalepsy, as it is in hysteria, to determine whether the cataleptic phenomena are caused by some organic lesion. The same principle holds good here as applied to hysteria. The presence of numerous symptoms pointing to a functional affection of the nervous system is of less importance in the diagnosis than the detection of one positive symptom of an organic lesion. All cases of catalepsy should be carefully studied and the patient systematically examined lest organic disease escape detection.

Trance, somnambulism, ecstasy, or hysteria in its ordinary form is readily distinguished from catalepsy on account of the wax-like flexibility in the latter. Should cataleptic subjects go into a trance, or an hypnotic state, or become ecstatic, or hysterical, the presence of the characteristic symptoms of catalepsy would probably determine the diagnosis in favor of the latter affection. There might be danger of mistaking a case of catatonia for catalepsy were one not on his guard. Of the former, Spitzka says: "The most striking phenomena of the disorder are its cataleptic periods. The catalepsy is typical and extreme. For days, weeks, nay months, the patients are immobile, resembling sitting corpses, requiring to be fed by the stomach-pump, to be carried to and from their beds, and betraying neither by look nor word that they have any mental activity left."

> Case of a patient who was, on one occasion, placed with one foot on the ground and the other on the bench behind him, head flexed extremely, one arm raised to the horizontal position before him and the other in the same position behind him. The patient remained in this awkward, and what would be for a normal person impossible, position for an hour or more before his arms began gradually to descend. In another case the patient retained any possible position in which he was placed for a day at a time. The history of the case, which would show a pathetical emotional state, with a tendency to repetition of certain words and phrases, together with the prolonged cataleptic periods serve to determine the nature of the case. Spitzka ("Insanity").

There is little danger of mistaking catalepsy for the other forms of insanity with which it may be associated. In hysteria uncomplicated with the cataleptic phenomena, the local position of the spasm and the absence of the wax-like condition of the limbs would distinguish it from catalepsy. In hysteria

when the limbs are rigid they cannot be flexed without using considerable force. The peculiar position of the hands in tetany and the resistance offered by the muscles to putting the limbs in different positions would prevent mistaking this affection for catalepsy. There is probably no danger of confounding catalepsy for epilepsy if the paroxysms are observed by a person of intelligence, except in those cases of the latter disorder in which the initial symptoms closely resemble catalepsy. A sudden return to consciousness after the exhibition of cataleptic symptoms, the patient resuming his work at the point at which it had been left off or continuing a sentence from the word at which the interruption had occurred, just as if nothing had happened, is strongly suggestive of epilepsy.

Catalepsy may be feigned. Of course, it is an easy matter for a person to breathe quietly, and allow his limbs to be placed in different positions, as if they were made of soft wax, but it is not possible for one to maintain awkward and uncomfortable positions for a considerable length of time without the breathing, the appearance of the face, and the jerky tremor of the muscles showing evidence of fatigue. In catalepsy if a weight of several pounds be attached to the outstretched arm or slight force is employed to depress it, the limb will gradually descend to the side of the body without the person showing any evidence of effort to keep it from falling. Simulators, on the other hand, invariably endeavor to prevent the limb from being carried down by force.

Finally, catalepsy is said to have been mistaken for death. The waxy flexibility of the limb is never found after death. Anyone who has employed the ophthalmoscope to examine the optic nerves after death can never mistake the appearance of these and the whole fundi. Everything is blanched and bloodless. In the absence of the ophthalmoscope the stethoscope may be employed to detect the heart's action; a glass mirror may be held before the mouth and nostrils to determine whether the patient is breathing; the temperature of the body may be taken, but this, like the use of electricity, is not of much value to ascertain whether the patient is dead or alive, unless some hours have elapsed to allow the temperature of the body to fall and electrical changes to take place. Of tests for death, immediately after its occurrence, there is none, in my experience, equal to the use of the ophthalmoscope.

Prognosis.—Hammond thinks the disease does not, in the vast majority of cases, tend to become worse either in regard to severity or frequency of the paroxysms, especially in those cases in which the exciting causes are removed. Catalepsy due to malaria is curable. When the affection is the direct result of temporary emotional disturbance and the neurotic element of the subject is not too profound, a cure may take place. It is in this class that we sometimes meet with only one, or a few, attacks during a life-time. Traumatism to the head or spine may give rise to catalepsy that may be only temporary in character. In the majority of cases catalepsy, like hysteria, is a chronic affection and may last months, years, or even a life-time, with few or many paroxysms, depending upon modifying circumstances, especially education, the *morale* of the patient, the frequency, intensity, and character of the exciting causes. Catalepsy is probably never the direct cause of death.

Etiology.—The causes of catalepsy are predisposing and exciting. The consti-

tutional neuropathic condition of Griesinger is the favorable soil for the development of numerous neuroses, such as hysteria, insanity, epilepsy, chorea, and the phenomena of catalepsy. The hysterical neurosis is the one best suited for the manifestation of the cataleptic phenomena. Congenital preformations, as Eulenburg terms them, of certain portions of the central nervous system predispose to catalepsy. In families in which in one or more members hysteria or catalepsy has developed, other nervous disorders—such as insanity, epilepsy, chorea, or alcoholism—are often found. In some cases epilepsy precedes the manifestation of cataleptic phenomena; in others epilepsy begins with symptoms of a cataleptoid nature. The inheritance of degenerative tendencies favor development of most neuroses.

> Description of a case studied by Dr. George E. de Schweinitz in a child, female, 2½ years old, in which cataleptic phenomena, with a condition of automatism very similar to the manifestations exhibited by some hypnotized subjects, were witnessed for a period of several weeks. C. K. Mills ("System of Med.," edited by Pepper, vol. v, p. 316).
>
> [So far as I know, this is the youngest subject on record in which the cataleptic phenomena have been observed. J. T. Eskridge.]
>
> Case of catalepsy in a girl 3 years old. A. Jacoby (Amer. Jour. of the Med. Sci., vol. lxxxix, p. 450, '85).

This nervous disorder is most frequent at puberty and from that period to the thirtieth year. A number of cases have been observed in children. Moti, referred to by Mills, records eleven cases met with in children from the fifth to the fifteenth year, the average being nine years.

> Quite well marked catalepsy is sometimes observed in young children of one or two years when they are ill. Probably they fall into a sort of stupor; or often it seems that they are rendered hypnotic, as it were, by the presence of strangers. Strumpel ("Text-book on the Practice of Med.," p. 754, Eng. trans.).

Women are more likely to suffer from catalepsy than men, but the difference is not great. Of 148 cases collected by Puel, 80 occurred in females and 68 in males. Malnutrition, caused by insufficient or improper food, or conditions that interfere with digestion and assimilation, favor the development of catalepsy. Prostration following the acute fevers or profound mental or physical exhaustion would probably not give rise to the disease in a person who formerly had a healthy and normal nervous system; but in a neurotic subject such a cause might greatly enhance the predisposition, and with the addition of any emotional disturbance it would probably be sufficient to cause the development of the phenomena.

Strong and suddenly-induced emotion may be classed among the first of the exciting causes. It may be in the form of moral shock, fright, anger, profound sorrow, great apprehension of evil, intense mortification, or religious excitement.

> The emotion is in the form of depressing moral affections, as chagrin, hatred, jealousy, and terror at bad treatment. Puel (Mills: Pepper's "System of Med.," vol. v, p. 318).

It is evident that any emotional influence that is great enough to disarrange suddenly the workings of the higher nerve-centres in a neurotic subject may be sufficient to produce various emotional manifestations, among which we may class catalepsy.

It is undoubtedly true that prolonged, depressing meditation and apprehension may give rise to the disease. The apprehension and uncertainty antedating and

attendant upon childbirth may favor the development of the nervous state or even give rise to it if the labor is followed by complications or depressing conditions.

> Case following the second confinement. Before the labor the woman had been very nervous, following it were a chill and rather high fever for a short time, and forty-eight hours later catalepsy with distinct hysterical symptoms developed. S. S. Cornell ("Psychological Med.," Mann, p. 470).

Painful menstruation, pregnancy, the parturient state, sudden suppression of menstruation, dysmenorrhœa, and masturbation are supposed to be causes of the disorder. Mills refers to reflex irritation as an exciting cause, and instances a case of preputial irritation, relieved by circumcision, occurring in the practice of Dr. James Hendrie Lloyd.

> Case recorded by Austin, in his work on "General Paralysis," in which the cataleptic seizure was apparently due to fæcal accumulations. The attack disappeared promptly after the bowel had been emptied by means of an enema. Mills (Pepper's "System of Med.," vol. v, p. 318).

Traumatism, such as blows to the head or spine, may give rise to catalepsy. Eulenburg cites a case seen by Jamieson in which a blow on the right side of the back was followed by an attack. Periodic attacks of catalepsy have resulted from malaria, and yielded promptly to antimalarial treatment. Hammond mentions one case in which worms in the intestinal canal were the apparent cause. Gastro-intestinal irritation in general is a frequent cause of catalepsy as well as of hysteria. Mills mentions the fact that catalepsy may occur as an imitation of epidemic nervous disturbance.

Opium and anæsthetics have given rise to nervous conditions in which cataleptic phenomena have been prominent. Eulenburg, in discussing theory of the muscular condition in catalepsy, says: "The observation often made, that narcotics and anæsthetics, at a certain stage of their action, before the production of narcotism, may give rise to slight epileptic phenomena"; then adds in a footnote: "I have myself seen an exquisite case of *flexibilitas cerea*, alternating with trismus, opisthotonos, and general convulsions, in a patient poisoned by morphia (by 0.09 gramme—$1^1/_3$ grains—of the hydrochlorate)" ("Cyclopædia of the Pract. of Med.," Ziemssen, vol. xiv, p. 379). Rosenthal refers to somewhat similar results following the adminstration of anæsthetics and poisonous doses of morphine.

> In a somewhat ancient American medical periodical (No. Amer. Med. and Surg. Jour., vol. i, p. 74, '26) Charles D. Meigs, of Philadelphia, gives an interesting account of a case of catalepsy produced by opium in a man 27 years of age. The man had taken laudanum. His arms, when in a stuporous condition, remained in any posture in which they happened to be left; his head was lifted off the pillow and so remained. "If he were made of wax," says Meigs, "he could not more steadily preserve any given attitude." The patient recovered under purging, emetics, and bleeding. C. K. Mills (Pepper's "System of Med.," vol. v, p. 319).

Darwin, quoted by Meigs, mentions a case of catalepsy which occurred after the patient had taken mercury. He recovered in a few weeks.

> [I have often observed a rigid condition of the limbs in patients while taking an anæsthetic. It is a frequent occurrence under such circumstances, and is seen just before the stage of narcosis is reached. J. T. ESKRIDGE.]

It is important to bear in mind that a condition simulating catalepsy, trismus, and general convulsions may occur from lethal doses of morphine. Such

phenomena from the poisonous effects of opium must be exceedingly rare, and are probably indirectly due to the peculiar nervous organization of the patient.

Hypnosis, induced by the Charcot method, such as having the subject stare for eight or ten minutes at a bright object held so as to cause the eyes to look upward in convergence is often attended by cataleptic phenomena: the so-called first stage of hypnosis of Charcot. I have never seen this condition in hypnosis induced by the Nancy, or suggestive, method, provided no suggestions were made to develop muscular rigidity.

Catalepsy occasionally occurs in association with insanity. It has been met with in connection with mania, melancholia, and paralysis of the insane. When it is observed among the insane it is most commonly found in the graver forms of melancholia, and in profound conditions of stupor. The mental condition under such circumstances is the cause of the cataleptic phenomena. One form of insanity, catatonia, first described by Kahlbaum, of Gorlitz, about twenty-three years ago, is always in its typical form attended by motor tension sufficiently marked to maintain the limbs in whatever position they may be placed for hours, or even a day or more, if we may accept the statements of Kahlbaum and Spitzka.

Finally, numerous organic diseases of the brain are sufficiently often attended with cataleptic phenomena to demonstrate a causative relationship between the organic cerebral lesion and the manifestation of the motor tension. These phenomena have been seen more commonly as transient symptoms in tumor, abscess, hæmorrhage, and softening of the brain, and in meningitis. It is a common experience to find a cataleptoid condition suddenly develop in cases of organic disease of the brain. It is probable that partial cataleptic states of the muscles would be detected more frequently than they are were physicians to examine for them in every case of brain disease coming under their observation.

> Conclusions after a study of fifteen cases: Cataleptic states which develop in the course of psychoses are often slight, brief, and partial. With increase of muscle-tension and enfeeblement of voluntary psychomotor activity they are often due to enfeeblement of perception of fatigue and to the persistence of communicated motor images; they may develop in a number of mental maladies, especially in alcoholic delirium, melancholy, mental confusion, manias, periodic insanity, the delirium of degenerates, and in congenital or acquired mental feebleness; they may precede or follow an epileptic crisis; hysteria is rarely connected with them; there is no catatonia of Kahlbaum; and these states are easily simulated. Paul le Maitre ("Contributions à l'Etude des Etats Cataleptiques dans les Maladies Mentales," p. 96, '95).

Pathology.—The examinations of the bodies of some cataleptic subjects, who during life presented undoubted evidences of organic disease of the brain, have revealed certain gross lesions of the central nervous system, especially of the brain. These findings prove nothing in regard to the pathological anatomy of catalepsy, because the autopsies, held on the bodies of persons who during life presented distinct symptoms of catalepsy without evidence of organic brain disease, have been attended with absolutely negative results. We are, indeed, in absolute ignorance of the pathogenesis of catalepsy.

In regard to the theory of muscular rigidity and the wax-like flexibility of the limbs, observed as the most significant symptom of the phenomena of cata-

lepsy, speculation has been rife. In the present state of our ignorance concerning the intimate nature of the subject, the most elaborate theories are only speculations.

In the normal condition the constant muscular tonus seems to be sufficient to adapt the muscles for lengthening and shortening without any disturbance of the harmony of action between the synergic and antergic groups of muscles concerned in extending and flexing the limbs. The nervous reflex concerned in maintaining the nicely-adaptable muscular tonus is composed of the muscle-nerves and the motor cells of the spinal cord. We have every reason for believing that the higher nerve-centres control, probably by inhibition, the lower ones; and that in case the inhibitory power of the higher centres over the lower is impaired or lost, the latter centres may run riot and cause exaggerated muscular tonus. In catalepsy the highest nerve-centres seem to lose their inhibitory power over the lower; and hence we find an increase of the muscular tonus. Did we not have to go further and explain certain other phenomena observed in catalepsy we should have little difficulty in accepting the theory that impairment or loss of the inhibitory power of the higher nerve-centres is the direct mechanism by which this affection is produced. In other and widely different conditions from the one under consideration, in which we know that the communication between the higher and lower nerve-centres is made difficult or entirely impossible, as witnessed in lesions in the upper portion of the cord and in the motor regions of the brain, the muscular tonus is not only increased, but the deep reflexes are also increased and the typical wax-like condition of the muscles, as observed in catalepsy, is rarely seen. In catalepsy, on the other hand, while the muscular tonus is increased, the deep reflexes are diminished. It is a curious fact that comparatively mild passive motion will cause the limbs to mold themselves in various positions in catalepsy; yet a far greater stimulant to muscles, muscle-nerves, and cutaneous nerves—the strongest faradic or galvanic current—fails to accomplish the same result.

> [This does not seem to me so difficult of explanation as Eulenburg seems to infer. By passive motion the limbs are not made, even in catalepsy, to assume different positions on account of any stimulation, either direct or indirect, communicated to any reflex nervous apparatus, but the change in position of the limb is the result of mechanical force, applied usually to the best advantage to accomplish the desired result. On the other hand, when electricity is applied to a group of muscles to cause flexion or extension of a limb, the power does not act to the same advantage to cause the limb to assume different positions as is the case when passive motion is employed; besides in the use of strong currents of electricity diffusion of the currents to a greater or less extent takes place, and in consequence, indirect stimulation of the antagonistic group of muscles results. J. T. Eskridge.]

Rosenthal thinks the waxy mobility is due to reflex contraction. Eulenburg, in commenting on this conclusion, states: "To the latter view we are at all events driven; but just the 'how?' and the 'wherefore?' of the form or reflex action is, alas! still unknown to us."

At the present day it is impossible to account for all the phenomena that occur in catalepsy. That it is a symptom of a disordered condition of the highest nerve-centres, the cerebral cortex, seems to be a fact. That during the attacks, the nervous system, especially the spinal representatives of it, is in an excitable

state, with a disarrangement of the normally-adjusted influence of the higher nerve-centres over the lower appears to be equally true. When the pathology of hysteria is thoroughly understood then we shall be able to explain many, if not all, of the manifestations observed in catalepsy. Until then we may observe and gather facts to be utilized.

[No one in discussing the theory of the mechanism of the phenomena that occur in catalepsy has apparently taken into account the possible influence of suggestion. J. T. ESKRIDGE.]

Treatment.—This should consist of measures for the relief of the paroxysm, and the employment between the attacks of those agents most likely to aid in toning up the nervous system, together with such changes in the daily life and surroundings of the patient as are best adapted to improve the mental state.

Literature of '96 and '97.

Two cases showing the beneficial effects of thyroid medication after the complete failure of other methods of treatment.

Conclusions: 1. That in conditions marked by inhibition of sensory, motor, and mental activity, without gross organic lesion, such as are met with in catatonia and in certain types of stuporous insanity and melancholia, we may expect benefit from thyroid medication, judiciously used.

2. That the effects of thyroids in full dose bear a striking resemblance to many of the symptoms of Graves's disease, namely: orbicular weakness, consecutively conjunctivitis, skin eruptions, and temporary bronzing, without icterus of the eyes, profuse local fœtid sweats, subjective sense of heat and thirst, excessive metabolism, decided tachycardia, and the absence of any fixed relation between pulse-rate, respiration, and temperature. Joseph G. Rogers (Amer. Jour. of Insanity, July, '97).

During the paroxysm it is always well to unload the bowel with a high enema, consisting of about 3 pints to 2 quarts of warm water to which 1 or 2 ounces of the tincture of asafœtida have been added. After the bowels have been thoroughly opened in the manner indicated, $^1/_2$ ounce of the tincture of asafœtida in about 4 ounces of water may be thrown into the bowel high up and allowed to remain. If the attack is severe 15 or 20 grains of chloral-hydrate may be added to the tincture of asafœtida for the small enema, in which case milk should be used instead of water. If the stomach contains any undigested food $^1/_{16}$ grain of apomorphine may be given hypodermically. A free emesis even when there is no undigested food in the stomach may aid in aborting the paroxysm.

To shorten the attack inhalations of amyl-nitrite or an hypodermic of $^1/_{100}$ grain of nitroglycerin may be employed with advantage. Cool applications to the head and passing a piece of ice up and down the spine several times and following this by briskly rubbing the spine with a coarse towel greatly aid in establishing reaction. A mustard plaster to the nape of the neck and one over the stomach have the same effect. Diffusible stimulants, especially ammonia, may be used with advantage.

During the intervals the treatment and general management are of considerable importance, and should receive as much attention as in a case of hysteria. In the first place careful attention should be paid to the food and organs of digestion. The diet should be nutritious, easily digested, and abundant. If necessary, digestion may be aided by the ordinary means. A free action of the bowels should be obtained each day. Iron, arsenic, quinine, and strychnine should be employed in the building-up process.

Systematic, but not violent or over-fatiguing, exercise should be insisted upon for all those who are not too weak. A little gymnasium can be arranged in most bed-rooms, and the beneficial results to be derived from regular exercise for a few minutes night and morning can scarcely be estimated until after one has tried it. A cool or cold sponge- or plunge- bath should be indulged in night and morning, following the exercise. At the same time the patient should be kept in the open air as much possible.

If the patient is a child or young adult the education should be judiciously supervised, and all oversentimental and emotional books excluded. Companionship for such patients, be they children or adults, is of great importance. In short, everything in reason that tends to develop muscle and improve the mental and physical condition of the patient should be encouraged, while exhaustion, depressing agents, poor nutrition, and emotional excitement should be avoided if possible.

J. T. Eskridge,
Denver.

CATARACT.—Gr., *καταραχτης*; from *καταράσσειν*, to fall down.

Definition.—By the term "cataract" is meant an opacity, partial or complete, of the crystalline lens.

Varieties.—The opacity of the crystalline lens may be (*a*) primary or idiopathic, (*b*) secondary to diseases of other ocular structures, and (*c*) symptomatic of other disorders.

Symptoms.—The objective symptoms vary according to the variety of the cataract, being mainly dependent upon the extent, the character, and the density of the lenticular opacity.

In the immature forms the anterior chambers may be shallower than normal, this being due to a forward protrusion of the iris, produced by a swelling of the lens. In hypermature cataract the anterior chamber may become deep, while in the mature condition it is practically of normal size.

The mere inspection of the pupil without the aid of oblique illumination does not always give conclusive evidence in regard to the presence of cataract; yet, generally, especially in fairly-advanced cases, the pupillary area appears dull gray or glistening white, according to the character, the condition, and the age of the lenticular opacity; a condition, however, that needs careful clinical confirmation before any certainty as to diagnosis can be vouchsafed. At times the pupil may appear almost entirely black or brown in tint. In some, particularly indeterminate cases of this type, the catoptric test is of value. Very rarely, glistening polychromous, crystalline masses may stud the pupillary area.

Study of the eye-ground in the incipient stages will frequently, especially in comparatively young and ametropic subjects, reveal coarse local changes connected with the uveal tract. In all cases, except when contra-indicated, and in all stages, mydriatics should be resorted to, to make as thorough a study of the intra-ocular conditions as possible. Vision is always disturbed to a greater or less degree, according to the situation, the extent, and the nature of the opacity.

The subjective signs are fairly constant in all forms of cataract. Large, circumscribed, peripherally-seated opacities are much less destructive to sight than small ones, or even faint nuclear haze situated opposite the pupillary area. Nearly always during the formative period, motes, "veils," and "cobwebs" are spoken of, while at times multiple and distorted vision is the chief com-

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plaint. As the lens becomes more opaque, however, the sight becomes more and more reduced, until, eventually, any large objects can no longer be discerned, although if the condition be uncomplicated, the distinction between light and darkness remains.

During the incipient stages of cataract it frequently happens in the aged that they are able to dispense with lenses ordinarily used for near-work, and at times require concave ones for distant vision. This, which is due to an increase in the refractive power of the eye, consequent upon swelling of the lens, before any opacity makes its appearance, is known as "second sight." Pain and photophobia, which are best relieved by smoked glasses, are rather infrequent symptoms in the early stages, and are referable to the pressure of the swelled lens on the ciliary body and iris.

As already stated, there are three varieties of cataract: (*a*) primary or idiopathic, (*b*) secondary to diseases of other ocular structures, and (*c*) symptomatic of some systemic disturbance.

A cataract may remain permanently limited to some particular portion of the lens, or it may gradually involve the entire lens-substance and lead to complete opacification.

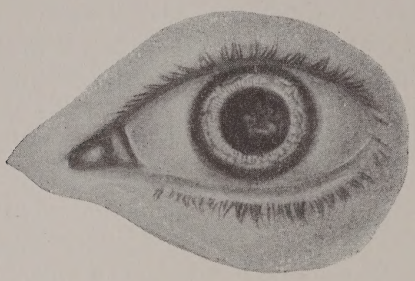
The former variety, which is divided into several types, dependent upon the locality of the lens involved, may be either congenital or acquired. When the opacity is situated in the anterior pole of the lens, the condition is known as anterior polar cataract or anterior pyramidal cataract. The cause of the congenital form is supposed to be due to some fœtal disturbance operating during the development of the lens. In the polar variety, which, in reality, is one of the true cataractous forms, the opacity assumes the figure of a star or rosette, with its radii extending toward the periphery. It has been seen to follow contusions of the globe, to appear as a part of pigmentary retinitis, and exhibit itself as a consequence of uveitis. The post-natal form, as a rule, is the permanent result of rupture of a corneal ulcer, by which the anterior capsule of the lens is brought into contact with the inflamed cornea, leading to proliferation of the epithelial cells of the lens occupying the position of the pupillary area, with the formation of a subcapsular opacity after the reformation of the anterior chamber; this being in addition to the nebule, which, as a rule, but faintly marks the site of the previous corneal ulceration. When, in addition, there is a deposition upon the anterior

Capsular cataract. (*Becker.*)

face of the capsule which in itself is irregular, opaque, and thickened directly beneath, the condition is known as anterior pyramidal cataract: in reality an opacity in both the lens and its anterior capsule. The disturbance in vision depends upon the extent of the capacity. Treatment, as a rule, is unavailing, except the possibility of an optical iridectomy should the opacity be large and the pupil small.

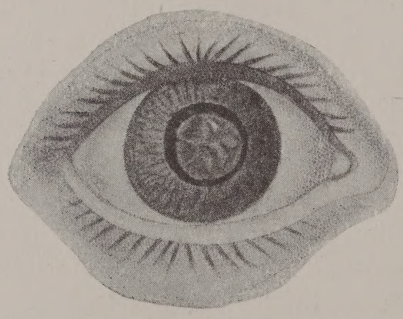
When the opacity is situated at the opposite pole of the lens, the condition is designated as posterior polar cataract, or posterior pyramidal cataract. In most instances the latter form, which is not a true cataract, is congenital in type, and is due to some interference with the incomplete disappearance of the hyaloid artery. It is recognized as a small dot

or point on the posterior capsule at the posterior pole of the lens, projecting backward into the vitreous humor. True posterior polar cataract is, at times, found as the initial point of election of the senile form, and is not infrequently



Posterior cortical cataract. (*Sichel.*)

seen associated with uveal disorder associated with lymph-stream disturbance and liquefaction of the vitreous body. Generally it appears in the stellar form of opacity. In this variety interference with vision depends not only upon the size of the opacity, but also upon concomitant and relevant changes. Treatment, to be of any avail, must be di-

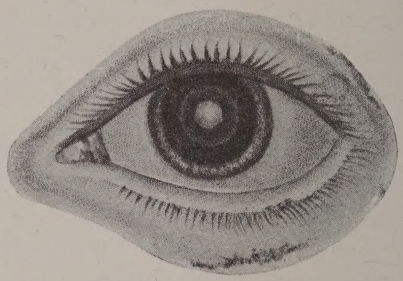


Congenital cataract with riders. (*Sichel.*)

rected, if possible, toward any existing cause.

A third form, although separated into quite a series of groupings, consists of localizations in various parts of the lens. Opaque stripes extending from pole to pole, and often combined with the central and the zonular forms, are known under the name of "spindle-shaped" or "fusiform" cataract. Minute dots, usually mostly situated in the central portion of the lens, and frequently grouped in the anterior cortex, are known as punctate cataract. Small spheroidal opacities in the nucleus, of congenital type, have, by some, been described as central cataract. As a rule, they are all mere concomitants of gross intra-ocular pathological change.

Zonular opacities situated between the nucleus and the cortex of the lens, both of these portions being transparent, are not uncommon. At times they may progress as a series of minute opaque



Congenital, nuclear, and perinuclear cataract. (*Sichel.*)

processes, or "riders," as they are termed, rendering the entire lens opaque. This variety of cataract, also known as perinuclear or lamellar, is either congenital or forms during infancy in rachitic subjects or those who have been affected with convulsions. Usually it is binocular, but it may occur in but one eye, and almost without exception is but very slowly progressive, though cases in which the opacity has become total have been reported. Upon account of the situation of the main opacity or opacities, vision is usually markedly disturbed, necessitating either artificial mydriasis, iridectomy, or lens-removal.

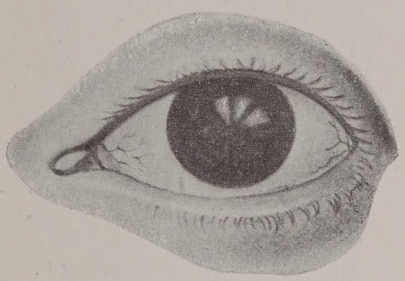
If the appearance of the lens shows

that the opacity is probably stationary, and if the zone of the opacity be not so broad that, after the pupil has been dilated with a mydriatic, vision is bettered, it is advisable to expose a portion of the transparent periphery of the lens by an iridectomy, thus obtaining an eccentric clearer pupil through which the subject can look. If, on the other hand the peripheral zone of transparent lens-matter be narrow, and if there be evidences of increase in the cataract, it is preferable to remove the lens, either by extraction, when the nucleus is well hardened, or by discission, when the lens-matter appears soft.

Traumatic Cataract.—As a rule, this form of lenticular opacity is the result of a rupture or disturbance of the capsule of the lens from an injury which permits the aqueous or vitreous humor to come into contact with the lens-fibres. The laceration in the capsule may be caused by either direct injury by means of the penetration of a foreign body or indirectly by contusion.

Shortly after the capsular laceration the lens-fibres near the rent begin to cloud and swell. Later, if it be the anterior capsule that is injured, they ooze out into the anterior chamber, appearing as gray, fluffy-looking masses. The aqueous humor, however, soon dissolves the lens-masses that have passed into the anterior chamber, and, gaining freer access to the interior of the lens by the removal of the primary plugs of lens-matter, causes more or less of the lens-substance to become opaque, swelled, and absorbed. In this way, after the lapse of some time, the major portion of the lens-substance may be dissolved and the pupil again become almost black. In most cases, however, the capsular wound cicatrizes and becomes closed, stopping the process of absorption before the removal of the lens-material by the spontaneous-liquefying method is fully attained.

Many cases of traumatic cataract pursue their course with but few signs of inflammation, but a successful termination is often prevented by the development of iritis caused either by direct injury or by pressure of loose or swelled lens-matter. Septic matter may be also introduced into the eye either at the time of the traumatism or later, giving rise to iridocyclitis, panophthalmitis, and even periophthalmitis. If not prevented it not infrequently happens that secondary glaucoma supervenes. This condition is generally due to either a



Well-advanced cortical cataract. (*Sichel.*)

blocking of the angle of the anterior chamber by pressure or the presence of a mass of lens-matter obstructing the passage of the aqueous humor through the spaces of Fontana.

The increasing forms of cataract are roughly divided into four stages. As a rule, they begin in isolated areas, but increase and multiply until all of the lens-substance is affected. The most frequent form is that known as senile cataract.

In the first, or incipient, stage the opacities usually begin in the periphery of the lens. They appear either in the form of spots or of stria, which radiate from the lenticular equator toward the

centre of the lens. This condition is known as cortical cataract. In other cases the nucleus of the lens may become quite hazy and opaque, while the periphery may remain comparatively clear. This variety is ordinarily designated as nuclear cataract. In most instances, however, the two forms, in which both the cortical and the nuclear portions of the lens are affected, are associated.

Clinically, in the stage of development of the cataract the anterior chamber will

Section through Morganian cataract. (*Becker.*)

be found but slightly shallowed or of normal depth, and the opacities will, by oblique illumination, appear as white or gray streaks and sectors with dots.

In the second stage, or that of ripening, the lens is swelled, this being due to the fact that it contains an increased quantity of fluid. The opacities are more pronounced, while numerous clear spaces are scattered throughout the lens-substance. As a rule, the anterior surface of the lens has an iridescent, bluish-white appearance. The anterior chamber is shallow. Clear spaces situated in the lens between the iris and the opaque portions of the lens-substance can be recognized by oblique illumination, allowing a shadow of the iris to be cast upon the lens at the side from which the light is thrown.

In the third, or mature, stage the lens has returned to its normal size, this being, in great measure, due to the loss of the lenticular fluids by resorption. The clear spaces in the lens-substance are replaced by opacities, and the anterior chamber has regained its normal depth. The iris fails to cast a shadow. The lens presents a dull-gray or waxy appearance, and its anterior face is seen to be situated on a level with the pupillary margin of the iris. Should the pupil be artificially dilated, it will be found that the red reflex from the fundus, which can be dimly obtained while the cataract is in its immature stage, is lost.

In the fourth, or hypermature, stage, as a rule, one of two changes occurs: either the cortical substance disintegrates and becomes fluid, while the nucleus remains hard,—so-called "Morganian cataract,"—or the broken-down cortical substance becomes more greatly inspissated and dries into a hard and somewhat flattened mass.

In hypermature cataract the anterior chamber is of normal depth, the iris fails to cast any shadow, and the surface of the lens appears either homogeneous or exhibits irregular dots in the situation of the ordinary physiological sectors. If, however, the overripening process be more advanced, fatty and calcareous degeneration occurs in the lens and its capsule, the anterior chamber becomes deeper than normal, and tremulousness of the iris can be seen.

In Morganian cataract the nucleus may sink to the bottom of the liquid contents contained within the lens-capsule, the walls of the capsule may come in contact with one another, and the volume of the lens-mass become increasingly smaller until nothing but a thin, transparent membrane remains: so-called "membranous cataract."

Practically, according as the dimensions of the nucleus of the lens vary, a cataract is spoken of as hard or soft. When there is no hard nucleus the cataract is said to be soft; so that, as a rule, all cataracts occurring in persons under 35 years of age fall under this category. In older subjects, however, the lenticular nucleus is larger and more or less sclerosed; so that opacities occurring in such persons are designated as hard cataracts, although the cortices of such lenses may be quite soft.

In some senile cataracts the general sclerosis becomes so pronounced that the entire lens is involved in it. In such a condition the cataract, as a rule, appears a dense, reddish brown and markedly translucent. This variety is usually termed "black cataract."

Secondary Cataract.—This condition refers to the changes that are, at times, observed in the capsule of the lens following, for example, extraction of cataract. It is frequently seen after the attempted removal of an immature cataract in which a portion of the lens-substance remains. This occurs when the capsular membranes become agglutinated together and the escape of any remaining lens-material is prevented. In many instances it happens that the entire pupillary area is not covered by the opacity, and fairly-satisfactory vision may be obtained.

When the condition does not develop until some months after the primary operation for extraction, it is generally dependent upon a fresh proliferation of the epithelial layer, with reduplication of the capsule.

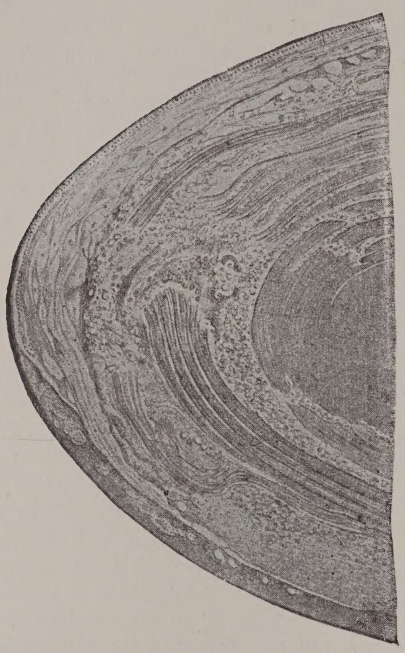
Etiology.—Congenital conditions operating upon the causation of cataract, which, at times based upon well-founded clinical observation, have been determined to be hereditary in type, practically resolve themselves either into developmental disturbances in the eye or antenatal inflammatory reaction of the organ.

> Stellate cataracts observed in thirteen members of the same family. Bergmeister (Wiener klin. Woch., Dec., '92).
>
> The influence of heredity in the production of cataract traced through six generations. In no instance was there any evidence of consanguinity. The transmission was effected by females alone. Fromaget (Gaz. Hebd. des Sciences Méd. de Bordeaux, July 30, '93).
>
> Instance of cataract in two sisters, aged 13 and 14 years, who were both idiotic and rachitic. In each case there was a history of convulsions occurring at 3 years of age. Guenther (Wiener klin. Woch., Nov., '92).
>
> The liability to cataract-formation increases rapidly from the fiftieth to the eightieth year, after which it becomes less. Neuberger (Centralblatt f. prak. Augenheilkunde, Sept., '93).
>
> Senile change does not produce cataract, but predisposes to it; the efficient determining causes are both ocular and general, while the general causes are not particular diseases, but the conditions arising in the course of disease. Jackson (Universal Med. Journal, Dec., '93).

General disease, independent of senility, particularly if of vascular or lymphatic type, becomes, at times, a causative factor. Thus, diabetes mellitus is responsible for about 1 per cent. of cases, this variety being bilateral and developing rapidly. Rachitis, nephritis, and some affections of the skin are credited with the production of the condition.

Example of a pigmented cataract, in a patient with diabetes mellitus of long standing. Immediately beneath the posterior capsule of the lenses were deposits of brown pigments, having the appearance of close, mycelium threads, and in their meshes were fine, dark-brown pigment particles. This deposit caused a peculiar greenish-brown pupillary reflex. Perles (Centralb. f. prak. Augenheilkunde, June, '92).

Cataracts are caused by a disorder of nutrition; that is to say, that they are



Formative changes in a degenerating lens. (*Becker.*)

a consequence of autointoxication by toxins in the organ, or by a failure in their proper elimination. Examination of 34 cases showed that the urine contained a co-efficient of toxic substances less than normal in 33 instances, while in but 1 instance was there an increase in these substances. Of the 33 cases, the urine of 13 contained less toxins than the lowest limit observed in ordinary pathological cases. Frenkel (Lyon Méd., July 9, '93).

Certain tonics, such as ergot and naphthalin introduced into the system, are eminently causal in character.

Local diseases and traumatism frequently produce all forms and varieties, especially in changes affecting the lymph-stream formation and circulation, and where the solvent power of the lymph-fluids can be made to exert their influence directly upon the unprotected and exposed fibres themselves.

Effects of pressure upon the crystalline lens in eyes which have undergone pathological changes: the lens is very prone to adapt itself to mechanical influences. If the effect upon it has been momentary it resumes its original form, but should the pressure or the traction last for some time the deformity persists. Hocquard (Archives d'Ophtal., Apr., '94).

Influence of astigmatism in the genesis of cataract: in 33 cases of bilateral cataract, 20 were found in which the more astigmatic eye first became cataractous, 5 were seen in which the less astigmatic eye was first affected, and 8 in which astigmatism was either absent or equal in the two eyes. Astigmatism should not be considered a cause of cataract, but rather as simply a condition which favors its development. Roure (Recueil d'Ophtal., Jan., '95).

Pathology.—By most recent authority, cataract is said to be, as a rule, caused by a too-rapid sclerosis and shrinkage of the nucleus. As one of the results, a cessation in the growth of the surrounding lens-fibres takes place. These separate from one another at certain places, especially in the area between the nucleus and the cortex, and particularly in the equatorial region of the former, producing fissures or cavities that gradually become filled with an albuminous liquid, which coagulates and produces spheroidal bodies known as the spheres of Morgagni. Later, the lens-fibres which constitute the walls of the fissures become translucent and unequally swelled, giving rise to large and

mostly nucleated vesicles of varying sizes and shapes. After total disintegration of these fibres and cells with their remains has fairly well taken place, the epithelium of the lens becomes abnormally thickened, the most peripheral lens-fibres become vacuolated, and the capsule of the organ becomes abnormally separated by the pathological process at work. In contrast to this breaking-down of the cortex, the shrunken and hardened nucleus, as a rule, remains practically unchanged.

Prognosis.—The diagnosis of cataract being once established, it frequently becomes necessary to be able to decide how long it will take for the cataract to become mature, or what is known as "ripe." This is very difficult, as the rate of progress is extremely variable. Senile cataracts may require years to become sufficiently opaque and hardened for operative interference, while, on the contrary, in a few rare instances, they have ripened over night. It is generally wise, therefore, if the signs of cataract be discovered in elderly persons not to alarm them by telling them of its existence, as vision may not be seriously disturbed for a long time. Particularly is this so in nervous females in frail health. Under all circumstances, however, it is better that the diagnosis be communicated to some responsible friend or relative of the patient. At times, among men especially, those who are harassing themselves with monetary and business affairs, it is best to acquaint them with the nature of the disturbance in order that better hygienic living may be obtained.

As a general rule, cataracts in the young, those due to general dyscrasia, and the secondary forms, all develop rapidly. On the contrary, all forms of opacity which commence in the periphery as narrow radii are slower in extension than those in which there are dot-like and broader opacities.

In reference to the prognosis of the result of operative interference for the removal of cataract, numerous factors must be taken into consideration. In many cases it is essential to determine the probable condition of the interior of the eye by means of the so-called candle-test. No matter how dense a cataract may be, a patient with a healthy fundus should be able to recognize the position of a candle-light placed in all parts of the visual field while the organ is constantly directed toward a second candle situated at a central fixation-point. If the moving light be lost at any point in the field, a disturbance of one or more of the ocular tunics may be diagnosed with almost certain precision and the prognosis rendered relatively unfavorable. If all light-perception be lost, operative procedure would be useless. The condition of the appendages of the eye must be noted, and any disease of them should be carefully treated.

The state of health of the patient should be good as possible. General dyscrasia and old age do not contraindicate operative interference, although they render the chances of a successful termination somewhat less.

Instance of partial spontaneous disappearance of an opacity of the lens. The opacity was the effect of a powder-burn. Noyes (N. Y. Eye and Ear Infirmary Reports, '94).

Literature of '96 and '97.

Spontaneous absorption, whether slow or rapid, takes place only when certain changes occur in the epithelium of the lens-capsule by which an abnormal process of osmosis is established. Reference to analogous phenomena connected with disease of the renal and vascular endothelia, as well as to the opacities of the

cornea, which may be brought about experimentally by merely scratching the endothelial lining of Descemet's membrane. Baquis (Ann. di Ottal., vol. xxvi, p. 2, '97).

Profound anæmia, depressed mental conditions, and pulmonary complications, on the other hand, are all extremely apt to militate greatly against any operative success.

If the removal of the lens is deemed advisable in young persons, it should be done as early as possible. In all cases the condition of the patient's general health should be carefully considered and given the greatest weight in determining the time for a cataract operation. Jackson (Amer. Lancet, Nov., '93).

The surroundings of the patient, the character of the place of operation, the time of year, and the hour of the day must all be taken into consideration. The more aseptic the conditions under which the operation is to be performed, the greater are the chances of a successful termination; in fact, this is the greatest of all the prognostic factors. Operations performed in hospitals are much more certain to be successful than those which are performed in private houses.

In regard to the effects of the character and the condition of the cataract itself upon the prognosis, the general rule is that the more nearly mature the cataract is, the more certain are the chances of resultant good vision. In some very old subjects, where the nucleus of the lens is large and well sclerosed, extraction may be made with every chance of eventual success. Operations upon overripe cataracts are not apt to be very successful. The frequency of fluid vitreous, the degenerate condition of the zonule, and the density of the capsule, all are serious complicating conditions.

The absence of perfect ripeness invariably diminishes the chances of success, and that, with favorable conditions, the percentage of successes should reach 85 per cent., with total loss of the eye in 2 per cent. Derby (Boston Med. and Surg. Jour., Jan. 31, '95).

Literature of '96-'97-'98.

The current view of the necessity to wait for the so-called maturity of senile cataract needs to be modified. Conclusions: 1. A senile lens, however small the opacity may be, is coherent enough to admit an easy extraction *in toto* by the proper methods. 2. To wait for the so-called maturity is unnecessary. The operation can be performed as soon as the sight is impaired to such a degree that the vocation or comfort of the patient is interfered with. 3. All operative procedures for artificial ripening are unnecessary and are contra-indicated, exposing the eye to a twofold danger. Barck (Ophthalmic Rec., June, '98).

Reports of 400 extractions of senile cataract by Prof. von Rothmund, of which 25 were complicated: The visual acuity was satisfactory (at least $^1/_{10}$) in 63.5 per cent.; 1.7 per cent. were total failures. Prognosis: while positive response to the usual tests is in general favorable, it does not absolutely exclude disappointments. Thus, in 1 case with normal function to ante-operative tests, an old detachment of the retina was found after extraction. On the other hand, 5 cases with complete lack of power to recognize colors resulted in good vision and presented no complications whatever. Of 39 cases of hypermature cataract the vision was satisfactory in but 18; in 10 cases of adherent cataract the result was satisfactory in 5. Ebner (Münch. med. Woch., vol. xliv, Jährg. No. 16, '97).

As long as a person has the capacity to read with the fellow-eye, it should be let alone. The moment he is not able to read with the other eye, an extraction should be performed, with the understanding that almost certainly a subsequent needling operation of the opaque capsule might be safely undertaken.

Dudley S. Reynolds (Ophthalmic Rec., June, '98).

Treatment.—The removal of cataract can be secured only by operation. Reported instances of its cure by absorption, by means of drugs, or by massage are misleading, and usually emanate from persons or institutions devoted to the purpose of mere monetary gain. It it probable that the temporary visual improvement which is, at times, obtained by such patients is due to the instillation of a mydriatic, for, if the opacity be central, dilatation of the pupil may be rendered sufficiently large to remove the iris from before the clear periphery of the lens, thus permitting vision through the unobstructed portion of the lens. Unfortunately, however, the improvement, which, at best, is but temporary, lasts only during the time of the effect of the drug.

The development of cataract may be retarded by careful and repeated correction of any existing anomaly of refraction and by constant care of the patient's general health.

Operations.—There are two operative methods of treating cataract: one by absorption and the other by extraction. The first is applicable to soft cataracts only, and is consequently limited to those found in young subjects. It has for its object the bringing of the aqueous humor into contact with the lens-fibres by means of an artificial opening made in the anterior capsule of the lens. This is accomplished by entering a needle, especially prepared for the purpose, through the lower and outer or upper and inner quadrant of the cornea, and incising those portions of the anterior capsule of the lens which are situated opposite the pupillary area.

The pupil should have been primarily dilated as much as possible with some efficient mydriatic. Care should always be taken, particularly in very young subjects, that the capsular incisions are not made too extensively and that they do not penetrate too deeply into the lens-structure, in order that the lens-mass may not be disturbed too greatly.

General anæsthesia is not necessary. The instillation of a few drops of a 2-per-cent. solution of hydrochlorate of cocaine is sufficient to render the operation painless. The patient should be placed in a recumbent position and the eyelids should be separated either by a speculum or by an elevator and the fingers of an assistant. After the procedure a few drops of sulphate of atropine should be instilled into the conjunctival *cul-de-sac* and ice-compresses applied until the eye becomes free from any signs of operative irritation.

If no complications arise and there be sufficient reason, the operation can be repeated as soon as the absorption of the loosened cataractous masses seem to have been sufficiently accomplished and the mass itself has become stationary. The incisions in the second and any subsequent operations may be made more freely, as the danger of swelling of the lens-fibres is lessened, this being due to the diminished volume of the lens-material. In uncomplicated cases the absorption of the cataractous masses is generally accomplished in eight or ten weeks' time.

The principal complications of the procedure are iritis and secondary glaucoma. The first is supposed to be caused either by pressure or "chemical irritation" exerted by the lens-matter on the iris. As a rule, it may be prevented by keeping the pupil well dilated with some powerful mydriatic or combination of mydriatics. If the second form of complication appears, the lens-matter should be

immediately removed by extraction through a linear incision.

In traumatic cataract the patient should be placed in bed as early as possible. Ice-compresses should be applied either constantly or intermittently to the eye in order to reduce inflammatory reaction, and atropine should be instilled at regular intervals to prevent the occurrence of iridic inflammation. Ordinarily under such plan of treatment, the lens-substance will gradually absorb without any complicating disturbances. The danger of secondary glaucoma with its accompanying symptoms should never be lost sight of, and intra-ocular tension should be repeatedly tested. If such symptoms should intervene, as much of the lens-matter as proper at the time should be removed without delay. This may be readily accomplished by a simple incision through the cornea into the anterior chamber and the softened lens-masses carefully and gently coaxed out along the groove of a Daviel spoon.

In operating upon shrunken or membranous cataracts, it is not so essential to provoke absorption of the remaining cataractous material as it is to obtain a clear space in the toughened and opaque capsule through which vision can be gotten. The operation is ordinarily performed by means of two needles which are passed rather obliquely through the cornea, one near to the nasal and the other close to the temporal border of the membrane. This done, both are pushed backward into the chosen portion of the opacity, and the points of the instruments separated from one another in such a manner that no traction is exerted upon the iris and ciliary body, thus producing a clear hole in the membranous mass.

Literature of '96 and '97.

Complete atropinization of the eye before extraction of cataract is extremely favorable to the successful issue of the operation. Confirmed by a trial of the method in one hundred and seventy cases. Out of these, prolapsus of the iris occurred only in seven cases,—*i.e.*, 4 per cent., while before the use of atropine the percentage of prolapsus was fifteen. Muttermilch (Gazeta Lekarska, No. 9, '96).

Simple linear extraction is applicable to the removal of both the soft and the membranous varieties of opacity. It is preferred by many operators to discission, and may be employed in any case where the lens-substance is sufficiently soft to flow through a small corneal wound.

The operation is performed as follows: After a speculum has been inserted, or the eyelids separated by an assistant, the globe is grasped by a fixation-forceps, and the point of a keratome or the tip of a von Graefe knife is entered into the anterior chamber through the cornea, usually about three or four millimetres from the limbus. If the former instrument is used, it is passed directly through the corneal membrane, but, as soon as its tip enters the anterior chamber, the cutting-blade is laid upon a plane that is parallel to that of the iris. It is then pushed forward until the corneal wound has obtained a length of several millimetres. It is then slowly withdrawn, in order to prevent the aqueous humor from coming away too quickly, with the possibility of a prolapse of the iris. If a von Graefe knife is used, the movements given to the instrument must be very carefully performed, in order to avoid wounding the iris-tissue. A cystotome is passed into the anterior chamber through the same corneal wound, care also being

taken to avoid wounding the iris. Free incision in the anterior capsule of the lens is then made with it. After the incisions have been accomplished, the cystotome is withdrawn, and the loosened lens-matter is evacuated, as previously explained, by means of a Daviel spoon. If necessary, the operation may be done with the addition of an iridectomy. In this event, the corneal incision is made nearer the limbus and should be slightly longer. After the withdrawal of the knife, the tips of an iris-forceps are to be introduced into the anterior chamber and a fold of iris directly over the sphincter of the pupil grasped and gently drawn through the wound and cleanly snipped off with a pair of fine scissors. Cystotomy and extraction of the lens-massings then follow, as just detailed.

As it frequently happens that lens-matter is left behind, a number of operators practice its removal by suction-syringes of special construction. The procedure, however, has never obtained general favor.

The operation for the removal of a hard cataract consists essentially of three steps: the corneal incision of sufficient size to permit of the passage of the lens; an incision, or a series of them, into the anterior capsule of the lens (cystotomy) in order to allow the egress of the lens-matter through it; and the delivery of the lens-substance from the eyeball itself. Before the actual operation is made, certain preliminary details should be carefully attended to. A general warm bath should be given to the patient the night before the operation. Care should be exercised to make his head clean with Castile soap and water. The bowels should be relieved by a gentle laxative, in order that they may not be disturbed for the first few days after the operative procedure.

The instruments, with the exception of the knives, which should be immersed in alcohol for at least twenty minutes prior to their use, should be boiled. After the cleansing has been completed, they should be kept in a tray of alcohol during the entire operation, being dipped for a few moments in a tray of sterile water just as they are being picked up for use.

The patient having been carefully prepared and the field of operation having been excluded from external contamination for a couple of hours previously by a few turns of a roller bandage, his eyelids, eyebrows, eyelashes, and adjacent parts should be thoroughly washed with a saturated solution of boric acid. The lids should be gently everted and the upper and lower *cul-de-sacs* flushed with the same character of solution. Several drops of a 2-per-cent. solution of hydrochlorate of cocaine are then introduced into the eyes at five-minute intervals, for about fifteen minutes before the operation, care being taken that the eyelids are kept closed and that a clean towel is thrown over the field of operation. If possible, the patient should lie flat on his back in the bed that he is to occupy. If circumstances do not permit this he should be placed upon some form of operating-chair or table. The source of light should be situated so that there shall be a field of uniform illumination upon the exact points to be operated upon. If the surgeon be ambidextrous, he may place himself in front of the patient or behind him in accordance with comfort and existing circumstances. A trained assistant should be present and assume such a position that he may be able to hand the instruments to the surgeon or receive them from him with such skill and rapidity that the operator may be

able to keep his vision fixed upon the field of operation during the successive stages. Prior to any procedure it is well for the surgeon to speak kindly and quietly to the patient for a few moments to gain his confidence and at the same time inform him of certain movements of the eyes that may be necessary during the operation. He should be cautioned against holding his breath and straining and told to resist all desire to close his eyes forcibly. By these few injunctions quietly and authoritatively given, the most intractable patients may be rendered obedient, the soothing words thus given often bearing fruit to the surgeon a hundredfold.

All these minor, but most essential, preliminaries being satisfied, the eyelids are to be separated by an elevator held in the hands of a skilled assistant, who is capable, if necessary, to momentarily remove the instrument without any damage to the organ. The patient is asked to look down. The globe is firmly held in any desired position by gently taking a fold of bulbar conjunctiva about two or three millimetres' distance from the corneal limbus within the grasp of a fixation-forceps held with one hand, while with the other the corneal section is to be made. The knife most generally employed is one introduced by von Graefe, which consists of a long, straight, narrow blade converging at its far extremity into a sharp point. Unless contra-indicated, the primary puncture should be made just within the margin of the clear cornea at the outer extremity of a horizontal line, which, as a rule, would pass three millimetres below the summit of the membrane. The cutting-edge of the knife should be situated upward and its point directed toward the centre of the cornea. After the tip of the knife has been made to enter the anterior chamber, it should be carried directly across and re-entered into the corneal tissue at the point desired. The section should then be completed by an upward movement so regulated that the corneal section is kept true and smooth throughout its entire extent. At this stage the elevator, in uncomplicated cases, is removed and not used again. The first stage of the operation being completed, the surgeon next addresses himself to the performance of the second stage, or that of capsulotomy, or so-called cystotomy. Directing the patient to look down and without any fixation-instrument in position, if possible, he introduces a cystotome, with the heel of the cutting-point first, between the lips of the corneal wound, and inserts the point of the instrument into the anterior capsule, without dislocating the lens, in such a manner as to be able to make a series of as free incisions as he may believe desirable and in such positions as he may deem the best. These having been obtained, the cystotome is withdrawn in such a way that the iris is not wounded during the procedure. The avenue of escape for the lens having been made, it remains to practically complete the operation by the performance of the third stage, or that of the delivery of the lens. The surgeon should, with the ball of the finger-tip of one hand upon the sclera just below the lower edge of the cornea, and a spatula held in the other hand and placed upon the sclera just above the corneal section, make a series of delicate, yet steady, upward and forward pressures and counter-pressures until just one-half of the lens has engaged in the corneal wound, when, by a dextrous and slightly tilting and upward motion from side to side, the lens will emerge without any complication whatever, and the corneal flap

will fall smoothly into place. Should the pupil not be round and should any lens *débris* be seen, the eyelids are to be closed and a slight gentle rotary motion be made upon the globe through the upper lid by the fingers. If there be any cortex remnants, the stump of the flap is to be slightly depressed and the masses gently, though as completely as possible, washed out of the anterior and posterior chambers by free irrigation from varying positions with warm sterile water or boric-acid solution without the introduction of any instrument whatsoever into the chambers.

After the lens has been delivered and anything, such as blood-clots and lens *débris*, which might prevent the proper union of the lips of the corneal wound have been removed, the conjunctival *cul-de-sac* is to be flushed with a warmed solution of boric acid and the pupil and corneal flap seen to be in proper positions. The eyelids of both eyes are then gently closed and held together, if necessary, by one or two narrow strips of isinglass plaster.

Literature of '96 and '97.

Sutures after cataract-extraction. Eleven cases with favorable results. Incision in the periphery of the cornea, inclining the edge of the knife slightly backward and cutting out with very gentle pressure, leaving a small flap of conjunctiva attached to the cornea. After the extraction of the lens this flap is united to the ocular conjunctiva by from one to three sutures of fine sterilized black silk. This secures the advantage of a conjunctival flap without any risk of its becoming rolled up or included in the wound; and lessens the danger of subsequent hernia of the iris or vitreous prolapse. C. H. Williams (Boston Med. and Surg. Jour., No. 16, '96).

A few carefully-adjusted and smoothly-applied turns of gauze bandage over squares of sterilized gauze properly covered by pledgets of absorbent cotton should be made without disturbing the patient. Strict injunction to remain quiet for at least twenty-four hours' time should be given, any necessary desires being properly cared for by competent attendants.

Case in which destruction of the eye by hæmorrhage followed the extraction of a cataractous lens, which had been dislocated downward, and which was safely removed by simple extraction without the use of a wire loop or of fixation of the lens. A few minutes after the operative procedure the patient complained of severe pain in the temple and back of the head. An examination revealed the presence of a copious hæmorrhage from the corneal wound, which was at once controlled by placing the patient in an upright position. There was a deep glaucomatous excavation in the other eye, but at no time could any hæmorrhages be observed in the fundus. Jackson (Annals of Ophthal. and Otol., Jan., '94).

The chief factor in the causation of ocular hæmorrhage after extraction is an increase in the blood-tension. Microscopical examination of an eye, which was lost as a result of such an accident, showed that the choroidal and retinal vessels had very much thickened walls and that there had been a classical total retrochoroidal hæmorrhage. The hæmorrhagic extravasation seemed to have originated at the entrance of the posterior ciliary vessels in the posterior and external regions of the choroid, and did not occur until three days after the extraction of the lens. Terson (Archives d'Ophtal., Feb., '94).

An instance of destructive hæmorrhage during extraction of a cataract: The patient was a female 82 years of age. The liquefied state of the cortical substance, the presence of cholesterin crystals in the lens, the sagging downward of the lenticular mass, the tremulous irides, and finally the very fluid vitreous, all gave indications of degenerative proc-

esses which had occurred in the eye before opacity of the lens had taken place. In this case the prolapse of vitreous followed immediately on the section, and a hæmorrhage appeared instantly after the delivery of the lens. Risley (Annals of Ophthal. and Otol., Jan., '94).

Case of double cataract extraction followed by hæmorrhage, with subsequent restoration of vision: The subject was 71 years old, and in a very poorly nourished condition. He was a sufferer from varicose veins over the whole body and exhibited other evidences of vascular disease. Gasparrini (Annali di Ottal., Oct., Nov., '94).

Intra-ocular hæmorrhage, with subsequent shrinking of the globe, following cataract extraction in a woman, 78 years of age, with degenerative heart disease: The patient died about eight months later from angina pectoris. Lee (Practitioner, June, '95).

Literature of '96 and '97.

Five cases in which no cause could be assigned for the hæmorrhage: There was no want of smoothness in the course of the operations except in one case, and this was so slight as to be ordinarily of no significance. Suggestion was made that a preliminary iridectomy is probably a valuable measure in these cases, and when done such have been reported as successful. Wadsworth (Boston Med. and Surg. Jour., Sept. 3, '97).

Choroidal hæmorrhage after cataract-extraction is by no means so rare as has been thought. Over 50 cases have been reported, and many remain unpublished. It is due solely to the diathesis of the patient, the principal cause being an atheromatous condition of the vessels, or an abnormal tension of the eyeball, suddenly reduced by the incision in the cornea and the outflow of aqueous. When such a hæmorrhage occurs the best treatment is to raise the patient's head, to relieve the pain, and to watch the eye carefully, at the same time being prepared to perform enucleation as early as possible. J. A. Spalding (Archives of Ophthal., vol. xv, No. 1, '97).

If no pain be complained of, the dressings should be allowed to remain for twenty-four hours, at the end of which time they should be removed, the eye inspected, and the conjunctival *cul-de-sac* gently flushed with a solution of boric acid. If all has gone well it will be found that the anterior chamber has re-established itself and that the eye is quiet. If there be any injection, if the pupil is small, or if any sign of inflammatory reaction be present, a drop or two of sulphate of atropine or, better, hydrochlorate of scopolamine should be instilled. At the end of forty-eight hours' time the dressing over the sound eye may be removed, but that on the operated eye, which can be made lighter, should be allowed to remain for another day, when plain smoked glasses or, if unobtainable, a suitable shade can be worn.

Literature of '96-'97-'98.

Attention called to the glaring-white haze complained of immediately after cataract extraction: This is a temporary loss of ability to perceive colors, such as the normal eye may experience when suddenly exposed to a flood of white light. S. M. Burnett (Ophthal. Rec., p. 17, '98).

To prevent tendency to prolapse of the iris and to favor smooth healing of the corneal incision, it is essential that the patient should rest absolutely quiet in bed for the first forty-eight hours. If he be old and feeble, more latitude can be given to his movements, which must be accomplished by the aid of careful attendants. At the end of the second day, a bed-rest may be employed, and on the third day, if the healing has been uncomplicated (which under the circumstances will be so almost without exception), the patient may be allowed to sit up. For the first twenty-four to forty-eight hours the diet, which is to be regularly given, should be liquid

and semisolid. On the third day the bowels can be opened by a gentle laxative. After this, liberal nourishment may be ordered.

The operation which has just been described is what is known as simple extraction, or extraction without iridectomy and is the one that is ordinarily in use to-day and should be the one chosen in all suitable cases in which there are no contra-indications.

Statistics of 549 cataract operations performed by Schoeler during the past six years: Of this number, 232 were operated upon by iridectomy, 317 without. Atropine was used in many cases after the first bandage was removed on the fourth day, the only indication against its employment being secondary glaucoma or possibly "thread-like keratitis." Of the 232 cases performed with iridectomy, 3 eyes were lost by suppuration after the operation. Iritis was observed 6 times, and glaucomatous symptoms occurred 7 times. In 7 instances discission of the secondary cataract was necessary from three to four weeks after the primary operation. In those eyes that were operated upon by the simple method, prolapse of the vitreous humor and iritis occurred 9 times. Glaucomatous symptoms were seen in but 5 eyes. In 20 instances the iris prolapsed. Discission of secondary opacities was performed 45 times. Disease of the general system was not found to be a contra-indication to the performance of cataract-extractions. Albrand (Archiv f. Augenheilkunde, Apr., '93).

Conclusions based on results obtained in 52 cases of extraction without iridectomy and 58 extractions associated with the removal of a piece of the iris: In selecting cases for simple extraction we are influenced (1) by the patients,—choosing those who are moderately-well nourished, in fairly-sound health, and of tranquil disposition; (2) by the eye,—accepting those in which the cataract is fairly mature, the pupils circular, the irides movable, the anterior chamber good, and the cornea of a fair size. Higgens (Lancet, Nov. 11, '93).

Fifty consecutive simple extractions without the occurrence of prolapse of the iris: Section made larger than for the combined operation; it should always be made entirely in the selero-corneal margin. Thorough cocainization before and after the operation with a 10-per-cent. solution will confine the iris within the eye. Gruening (Amer. Medico-Surg. Bull., Feb. 15, '94).

Results obtained in series of 465 cases of extraction: 75.2 per cent. were successful, 9.4 per cent. were partially successful, 7 per cent. were failures, and the results of 7.9 per cent. were not recorded. Nineteen cases in which the patients were 80 or more years of age showed entire success in all but 2 instances, and in 1 of these the success was partial, while in the other, which was a failure, the fellow-eye was lost through sympathetic inflammation. Higgens (Lancet, Aug. 11, '94).

Statistics of 70 cases of cataract extraction, 48 of which were performed by the simple method: Among these, loss of vitreous humor occurred twice, prolapse of the iris 7 times, and iritis appeared but once. In the 22 cases in which iridectomy was performed, the vitreous prolapsed twice. Fage (Gaz. Méd. de Picardie, Feb., '94).

One hundred consecutive extractions; extraction without iridectomy preferred; Knapp's method of making the capsulotomy followed. Discission resorted to in 88 per cent. of private cases and 60 per cent. of hospital cases, the operation being performed about three weeks after extraction. No cause to regret the extraction of an immature cataract. Weeks (N. Y. Med. Jour., Aug. 3, '95).

Study and comparison of 1032 cases of combined extractions and 1123 cases of simple extractions: Conclusion that the simple method extraction is far superior to all others in the very great majority of cases, and that, while it is a somewhat more difficult operation than the combined method, any experienced surgeon will find the results proportionately greater. Ring (Med. Rec., Feb. 23, '95).

Literature of '96 and '97.

Details of 1519 cases in which the operation of extraction was performed during the five years,—1889 to 1893 inclusive,—in the practice of eleven different surgeons: Extractions with iridectomy, 1091, as against 276 in which simple extraction was performed; while 161 had an iridectomy done some weeks at least before the cataract was removed.

The percentage of successful cases only amounted to 83.78, and 13.51 had no useful vision. Of all the 1519 cases the percentage of enucleation after extraction amounted to 1.90. Although needling is, as a rule, such a simple procedure, yet many cases subsequently do badly. Glaucoma occurred in 2.08 per cent. of the cases after secondary operations on the capsule, while it occurred in only 0.42 per cent. of cases after extraction. C. Devereux Marshall (Royal London Ophthalmic Hospital Reports; Universal Med. Journal, Mar., '96).

Many operators, however, still make use of an iridectomy before they expel the lens, justly claiming for this method that it enables them to get rid of any remaining cortical matter much more readily. They also state that it prevents prolapse of the iris and that the lens may be extruded through a smaller wound.

Those who prefer extraction without iridectomy urge that the advantages of a round, mobile pupil make it the operation of choice. The contra-indications are: an unripe cataract, increased intraocular tension, a small rigid pupil, and an intractable patient.

Despite the most careful precautions, prolapse of the iris does occur in a few case of simple extraction, usually appearing during the first twenty-four or forty-eight hours. If it be small, it may be let alone. If it be considerable, and the lips of the wound remain ununited, the line of corneal incision may be opened and the prolapsed portion of the iris excised with an iridectomy-scissors. Should the prolapse occur after the wound has united, it is best either to wait until about the tenth day, when a formal iridectomy can be made, or, if not productive of any irritation and the pupil is not much distorted, it can remain undisturbed, cicatrization and flattening subsequently taking place.

Glaucoma, which arises after the discission of secondary cataracts, may be often avoided by the instillation of eserine after the operation. Should this procedure fail, iridectomy is a reliable curative procedure. Knapp (Archiv f. Augenheilkunde, Dec., '94).

Literature of '96-'97-'98.

Prolapse of the iris can be prevented by exsecting a very small piece of the periphery of the iris. Pfluger (N. Y. Med. Jour., Jan. 8, '98).

Chandler and Myles Standish, of Boston, have for several years operated in the same manner with the same result. Herman Knapp (N. Y. Med. Jour., Jan. 8, '98).

In certain cases in which complications are feared, or when it is advisable to hasten the maturity of the cataract, an iridectomy known as preliminary iridectomy, can be performed some time before the extraction of the lens is made. If it is desired to ripen the lens after the iridectomy has been performed, the lens may be triturated with a spatula either directly applied to the anterior capsule or indirectly through the cornea. Rapid swelling and opacification of the lens is said to follow these procedures, and the extraction in many cases is made possible in several weeks' time after the operation. The lens-substance, however, in these cases seem to have obtained an undue degree of friability, which may be detrimental to the complete removal of the lens-substance.

Some operators have adopted the

method of syringing the anterior chamber after the removal of the main body of the lens, in order to remove any remaining cortical matter. As this plan, however, entails the bringing of another instrument, which may be an additional source of infection, into the eyeball, and is always attended by more or less local reaction, its disadvantages seem to be so many that its employment has never become general.

Literature of '96 and '97.

Details of last 400 personal operations: Incision entirely in the margin of the transparent cornea, in a plane parallel to that of the iris, and with a small conjunctival flap. Corneal incisions tend to be complicated by adherence of the iris and by keratitis; more peripheral incisions are disturbed by prolapse of iris and cyclitis. The conjunctival flap protects against infection of the wound: a matter of great importance in countries where conjunctival and lacrymal affections are common. The opening in the capsule is made with a cystotome, behind the upper part of the iris near the equator of lens, and is six or seven millimetres in extent. The lens is expressed without introducing a spatula; no instrument of traction is employed even in complicated cases. Reposition of the iris is made by means of a sound or stylet that is slightly curved. Binocular bandage is used. The patient need not be kept in bed. The dressing is changed after twenty-four hours, sooner if necessary; minute inspection of the eye and of the wound; immediate ablation of any prolapse of iris. Knapp (Annales d'Oculist., Oct., '97).

In order to prevent secondary cataract, the lens is, at times, removed in its capsule. This is accomplished by delivering it by a spoon or a loop, after an iridectomy has been performed, without the performance of a capsulotomy. As the operation is, at times, attended by loss of vitreous humor, it is not frequently employed.

Many of the accidents occurring during cataract extraction are the results of want of skill. In some instances, however, it happens that the patient's condition is such that a successful result can scarcely be expected. Deafness, loss of self-control, and great stupidity are all harmful and even injurious at times.

Although planned with the utmost exactness, it sometimes happens that the size of the lens is misjudged and the normal corneal section is made too small. If this occurs, the incision should be enlarged by one or two clean snips with a scissors. Should prolapse of the vitreous humor take place during the delivery of the lens, an iridectomy had better be carefully done and the lens removed with a loop or a spoon. Prolapse of the vitreous humor occurring after the extraction of the lens is much less serious for the time being. It interferes, however, with the proper coaptation of the lips of the wound and renders inflammatory action more liable, while in many cases it becomes a most harmful complication for the future welfare of the organ.

Usually there is some discomfort for several hours after the operation. Should this continue and be at all marked, the bandage should be removed and the eye inspected. At times great relief will be given by gently pulling down the lower eyelid and giving exit to an accumulation of tears or by allowing a faultily placed eyelash to escape into proper position. If the eyeball appears the least injected and the slightest signs of iritis be present, atropine should be immediately instilled into the conjunctival *cul-de-sac*. Suppuration may appear, usually taking place before the third or fourth day, and is traceable to infection, generally from lacrymal disease. In a few instances it is dependent upon a lack

of nutrition to the eye. If it is due to the former, it is best combated by cauterization of the edges of the incision, the instillation of sulphate of atropine, the use of hot compresses, and attention paid to the general health.

An eye whose lens has been removed is termed aphakic, and, in order that its vision may be useful, it must be provided with an artificial lens corresponding in relative strength to the crystalline lens that has been removed, plus a cylindrical one to correct any astigmatism resulting from cicatrization of the corneal incision. To this artificial lens must be added a convex spherical one of two or three dioptres' strength for use during near work. As cicatrization is usually not completed until four to six weeks after the operation, it is better to postpone ordering glasses until at least that time.

Literature of '96 and '97.

Corneal measurements after extraction of cataract: Conclusions from an examination of 59 cases:—

1. Two weeks after the flap-extraction of cataract there is corneal astigmatism varying from 1.75 D. with rule to 22.0 D. against rule.

2. The greatest amount of this astigmatism disappears in the following four to six weeks.

3. It is slowly reduced for six months, after which it seems there are no further changes.

Bearing these facts in mind, it is evident that an accurate estimation of the ultimate glasses cannot be made at the end of two weeks. A. O. Pfingst (Archives of Ophthal., July, '96).

CHARLES A. OLIVER,
Philadelphia.

CATARRH, NASAL. See RHINITIS.

CATARRHAL BRONCHITIS. See BRONCHITIS.

CATARRHAL LARYNGITIS. See LARYNGITIS.

CATARRHAL PNEUMONIA. See PNEUMONIA.

CEPHALHÆMATOMA. See TUMORS.

CEREBELLITIS. See ENCEPHALITIS.

CEREBRAL ABSCESS.

Definition.—Cerebral abscess is a focal suppurative encephalitis affecting either the gray or white matter or both. The abscess may be single or there may be several separate foci of suppuration. (See, also, ENCEPHALITIS.)

Symptoms.—The symptoms may be of acute rapid onset or they may develop slowly and insidiously during several weeks or even months. Clinically the symptoms are divisible into those which are general and those which are local or focal, the former being those of general diffused cerebral compression or irritation, the latter representing perversion or interruption of motor, sensory, or special function, varying according to the anatomical site of the abscess. Among the general symptoms which are most common are headache and lassitude, perversion of the intelligence and the emotions, disturbances of sleep and of consciousness, vertigo, vomiting, convulsions, and sometimes optic neuritis. These general symptoms will vary somewhat in degree and character, according to the mode of onset. When the abscess produces symptoms rapidly the headache is more intense; as a rule, there is a more active or decided involvement of intelligence and consciousness, sometimes manifesting itself in acute delirium or in profound somnolence or semicoma; there may be rigors, with an abrupt and decided rise of temperature, and the whole picture suggests an active

meningitis from which, indeed, it may be, and often is, difficult to distinguish it. General convulsions are not uncommon in cases with acute onset. When the symptoms are of slow gradual development they are usually much less intense in degree. The headache is relatively mild; the vertigo may be slight; vomiting may be absent or occur only rarely; instead of somnolence or coma there may be simple apathy, and a state of simple mental confusion with irritability may appear instead of delirium. The temperature in such cases is usually normal or subnormal; occasionally these patients will exhibit periods of remission attended with a very dangerous semblance of well-being and comfort. Sooner or later the disease becomes aggressive, and evidences of focal disturbance may be observed by which the site of the abscess may be determined. These focal symptoms will vary, as has been stated, in accordance with the function of the brain-area affected by the abscess. There are several methods of approach—short-cuts, so to speak—to a consideration of the focal symptoms. Brain-abscess is apt to develop in certain areas according to the cause with a constancy which is of decided value in localization. When due to an extension from ear disease, for example, the abscess is nearly always found in one of three localities: the temporo-sphenoidal lobes, the cerebellum, or the pons-medulla region. More than half of all cases are located in the temporo-sphenoidal lobes or the cerebellum. If the pus enters through the medium of a secondary phlebitis of the lateral sinus the abscess will quite probably be found in the cerebellum.

If the pus enters the superior petrosal sinus it will be found in the cerebrum and probably in the temporal lobe. When caused by trauma the abscess usually bears some relation in its location to the site of the trauma, though sometimes the pus-formation is at a remote part of the brain from the seat of injury, as, for example, in the occipital lobe, the blow having been received over the frontal region.

Cerebral abscess, when due to necrosis or disease of the bones of the face, is frequently located in the frontal lobes or at the base; when from syphilis or tuberculosis, its site is, as a rule, the motor convexity, the base, or the cerebellum. Pyæmia and other constitutional infections are apt to induce multiple abscesses, which seem rather prone to develop in the distribution of the middle cerebral artery of the left hemisphere. The data of cerebral localization should be applied in determining the site of the abscess in each instance. The principles of localization in cases of uncomplicated brain-abscess located in active regions apply with unusual constancy, the diffusion of symptoms being less than in tumor, hæmorrhage, or any other focal disease.

> There is little difficulty in recognizing the existence of cerebral abscess in which well-marked focal and constitutional symptoms coincide, or where a distinct abscess-producing cause, such as an ear trouble, a head-injury, or a putrid bronchiectasis, co-exists; "but there are a number of cases, varying from the latent form to forms with obscure general symptoms, whose recognition is impossible or at best a matter of conjecture." Spitzka (Pepper's "System of Med.," vol. v, p. 799).

It should not be forgotten, however, that brain-abscess occurs occasionally without any apparent focal symptoms at all, and sometimes, indeed, with very few general symptoms, the diagnosis being a post-mortem revelation.

> Analysis of 169 cases, including 6 personal. Of this number, 98 were cases of

abscess proper, and of these 40 were located in the temporal lobe and 31 in the cerebellum. Localizing symptoms were found, in a large proportion of cases, conspicuous by their absence. As to subnormal temperature, in only 2 cases of these 98 was the temperature below normal. The most constant alteration of temperature was a moderate elevation. Aphasia was present in only 6 of 40 cases, involving the temporal lobe, many of them on the left side. Frank Allport (Jour. Amer. Med. Assoc., Oct. 22 to Dec. 24, '92).

Personal case in which the patient had had no discharge from the ear, the only sign of disease of the mastoid process being dullness on percussion. The cerebral abscess had caused neither somnolence nor fever, but there was a lowered internal temperature and a diminution of hearing on the opposite side from the abscess. On the eighth day incessant hiccough supervened. It was seen on trephining that even very slight packing of the cerebral wound produced the same effect as the compression caused by the pus. The patient completely recovered. H. Eulenstein (Monat. f. Ohrenheilkunde, No. 3, '95).

Illustration of the difficulty that is occasionally found in ascertaining the cause of a cerebral abscess: A patient died of basilar meningitis. Post-mortem investigation showed purulent infiltration of the pia in the left middle fossa of the skull. This collection was quite circumscribed, and there was no connection demonstrable with the ear, which was free from disease. A tract of suppuration led, however, to the left cavernous sinus, which was found, when opened, full of pus. So far no light had been thrown upon the origin of the trouble, but further examination showed a very noticeable infiltration of pus in the sheath of the trigeminal nerve, which extended farthest in the periphery of the superior maxillary branch. This seemed, from the post-mortem appearances, to have been the avenue of introduction, and the supposition was apparently confirmed by the hospital records, which showed that three weeks previously the patient had suffered from a boil on the face exactly over the foramen of exit of the left infra-orbital nerve. Grawitz (Archiv f. klin. Chirurgie, B. 39, H. 2, '89).

While in many cases an acute abscess of the brain may be diagnosed with some certainty, a chronic cerebral abscess may exist and yet give no positive indication of its presence. Too often the condition is only discovered by post-mortem examination. The diagnostic indications of a chronic abscess of the brain are few and untrustworthy. Of first importance among such indications is the presence of a sufficient cause, such as middle-ear disease, local injury, or caries of the cranial bones. Not that the exciting cause need be so grave as these; the abscess may follow any of the specific fevers, and, as these occur so very frequently without leaving any such sequelæ, the connection may not be recognized. The signs of a chronic cerebral abscess are few in number,—pyrexia, headache, and optic neuritis,—but none of these can be depended on; pyrexia is often completely absent, and, as Murri points out, in many cases a subnormal temperature is present; the headache, if localized and persistent, and occurring after one of the usual exciting causes, is suggestive, but nothing more; and optic neuritis may equally be a sign of a tumor or meningitis. Other symptoms such as paralyses, though often of use in determining the situation of a lesion, are of no value in deciding as to its nature. If we have in any case a sufficient cause, and the signs already mentioned are well marked, we may be fairly confident that an abscess is present, but we cannot be at all certain. Augusto Murri (Lancet, Jan. 5, 12, 26; Feb. 2, '95).

Literature of '96-'97-'98.

Study of 32 cases, 13 of which were in children under one year of age, 9 of these being under six months and 5 under three months; 3 occurred during the second year, and 5 each in the third, fourth, and sixth years, no case being included in which the patient was five years old or over.

Conclusions: In a large proportion of

the cases only general symptoms are present, and these in very great variety. Focal symptoms may be misleading unless they are constant; and even then they may depend upon associated lesions, such as meningitis. Motor symptoms only can be trusted, since the sensory symptoms are difficult or impossible to determine in infants or young children. L. E. Holt (Archives of Pediatrics, Mar., '98).

Diagnosis.—Ordinarily it is quite apparent in patients suffering from cerebral abscess that some affection of the brain exists. It is by no means so easy always to decide that the symptoms are due to abscess. The diseases which most often confuse the diagnosis are meningitis, tumor, and sinus-phlebitis. The difficulty encountered in differentiating brain-abscess from sinus-phlebitis and meningitis is increased by the fact that the same causes may operate to produce either of them. This is especially true of trauma and the various infectious diseases and also of disease of the internal ear, though the latter points to abscess rather than meningitis or phlebitis. In all three the temperature is affected, but it is usually above normal and sometimes quite high in meningitis and phlebitis, while it is either below normal or quite irregular in abscess.

Literature of '96 and '97.

Although almost all observers agree that subnormal temperature is the rule in brain-abscess, it must not be depended upon. Case in which the temperature reached to 105° or 106° F., and was so irregular as to suggest pyæmia and thrombosis of the lateral sinus. Again, much stress is laid upon the presence of a cerebellar gait, yet this was often the result of irritation of the auditory nerve or of irritation of the semicircular canals. Optic neuritis is sometimes present, but not often, probably because there was no time for it to develop. M. Allen Starr (Med. Rec., Dec. 11, '97).

In meningitis the onset is usually more acute, the symptoms more diffused, the delirium is more conspicuous, the tendency to rigidity and generalized spasm is more marked; there is photophobia and a state of wide-spread cutaneous hyperæsthesia with accelerated respirations and irregular, high pulse. Focal symptoms are less common in meningitis except in cases affecting the base, when the number and degree of involvement of cranial nerves is more marked than in cerebral abscess. If the meningitis is localized and circumscribed, I do not believe it is possible to make the differentiation positively. Tenderness of the skull over the site of the disease points to abscess rather than meningitis in such cases.

Literature of '96 and '97.

Traumatic brain-abscesses may be confounded with traumatic meningitis, apoplexy, encephalitis, tumor, epilepsy, and traumatic neuroses. A one-sided traumatic apoplexy or a hæmorrhagic nonpurulent encephalitis may, from symptoms alone, easily be taken for abscess.

Suppurative meningitis occurring with an abscess is likely to be overlooked. An abscess of the brain is marked by normal or subnormal temperatures; fever is by no means a necessary symptom. If an attack begins with a rise of temperature, it is probably not due to an abscess of the brain, certainly not to an uncomplicated one. A slow pulse is, perhaps, the most reliable single symptom.

Patients suffering from ear troubles often become hysterical, and a hasty diagnosis of hysteria, even if the typical symptoms are present, may falsely be made in cerebral abscess of the otitic origin. Oppenheim (Fortschritte der Med., Nov. 15, '96).

In sinus-phlebitis the swelling back of the ear with tenderness on pressure and a cord-like hardness of the jugular at times will determine the nature of the condition with little difficulty. Within

the past year lumbar puncture has found some favor as a means of differentiating abscess from meningitis and sinus-thrombosis. If the fluid withdrawn is clear and does not contain micro-organisms the disease is probably meningitis. Excess of leucocytes also indicates meningitis. The diagnostic value of lumbar puncture is, however, exceedingly problematical as yet, and promises to remain so, in the opinion of the writer, so far as brain-abscess is concerned, for a very indefinite future.

In regard to the differential diagnosis between temporo-sphenoidal and cerebellar abscess, the error usually made is to mistake the latter for the former. There is rarely any excuse for this mistake; for, if the mastoid cells and the antrum are thoroughly explored, a clear indication is almost invariably obtained. Hugh E. Jones (Liverpool Medico-Chir. Jour., Jan., '95).

Literature of '96-'97-'98.

Most of the cerebral complications observed occur in connection with chronic cases of suppurative otitis media. One should be chary, however, about making a diagnosis of brain-abscess in these cases on the first appearance of cerebral symptoms; it is better to watch the case for two or three days before deciding, as not infrequently apparently serious cerebral symptoms gradually disappear as a free discharge from the ear is established.

Above and back of the ear is the region of the brain concerned in the storage of the memories of the sounds of words. If this part of the brain is injured, the person becomes unable to understand what is said to him. Again, everything that we call to mind by our visual sense employs the function of the occipital lobe of the brain: the visual centres. The connection between the hearing-centres in the temporal lobe and the visual centres in the occipital lobe is made by a long tract lying under the cortex of the brain: a distinct association-tract. When this tract is destroyed, as it often is, in abscess of the temporal lobe, if one ask such a person what some object is that is held up before him, he recognizes the object, but cannot call it to mind and name it, because of the destruction of this association-tract. This peculiar lack of association is an important symptom to elicit in cases of suspected abscess of the temporal lobe, yet it is not commonly mentioned in text-books. M. Allen Starr (Med. Rec., Dec. 11, '97).

Conclusions that in children the rapid progress, fever, and a history of injury or otitis generally make a diagnosis from tumor easy. In the slower cases, in which there is little or no fever, valuable assistance may be obtained from lumbar puncture.

From acute meningitis the diagnosis is more difficult, and in the cases in which there are only terminal symptoms the diagnosis is impossible. In the more protracted cases the distinctive points with reference to abscess are the slower and more irregular course and, as a rule, a lower temperature. L. E. Holt (Archives of Pediatrics, Mar., '98).

Etiology.—Abscess of the brain is always a secondary condition dependent upon the intracranial invasion of micro-organisms from adjacent or remote sources of infection. Any one of the pus-producing micro-organisms may act as an exciting cause. The affection may occur at any age, but is most frequently observed in adolescence and middle adult life. It is rare in very young children (Holt) and in old age. Males are more often affected than females in proportions varying from 3 to 1 to 5 to 1 according to the observer. By far the most frequent source of infection is purulent disease of the middle or internal ear. More than a third of all cases originate from this source (Pitt). Cerebral abscess is far more common from chronic than from acute suppurative disease of the ear. This fact has been established beyond question by an analytical study of several thousand cases (Jansen).

It was formerly admitted that the development of an otitic abscess necessarily implied a pre-existing chronic suppuration of the ear. To-day, however, it is known, from cases observed during the recent epidemics of influenza, that cerebral abscess may develop after an acute suppuration of the ear. Monnier (La Presse Méd., Nov. 6, '95).

More than one-half of all cases originate from aural disease. The statistics of Jansen, who found, in an aural clinic in Berlin, abscess only in the proportion of 1 case to 2650 cases of acute otitis, and 1 to 400 of chronic suppurative otitis, are misleading. Abscess is twice as frequent in adults as in children. As to Hessler's statement that three-fourths of all fatal cases of otitis present purulent pachymeningitis, it is found that in less than one-fourth of these cases is there any direct communication apparent between the tympanum and the extra-dural abscess, microbic migration having taken place through microscopic avenues. Taking 119 cases of true encephalic abscess, analysis shows, with reference to localization, 82 in the middle lobe, 24 in the cerebellum, 4 in both cerebrum and cerebellum, 3 in the pons, 2 in the occipital lobe, and 1 each in the frontal lobe and cerebellar peduncle. Cerebellar abscess is more frequent in adults than in children, in whom the location is almost exclusively in the temporo-sphenoidal lobe. Picque and Ferrier (Annales des Mal. de l'Oreille du Larynx, du Nez, etc., Dec., '92).

Statistics upon cerebral abscess following disease of the ear based on 100 cases personally observed, 91 being examined after death; in 9 the abscess was opened during life. The frequency of such abscesses in the cerebrum is nearly twice as great as in the cerebellum; in children below ten years of age their frequency is three times that of adults, this difference being, perhaps, the greater distance of the tympanum from the cerebellum in children. The liability of males is twice that of females, and the generally-admitted fact of the disease being more common on the right than on the left side is borne out by statistics.

As regards the extension to the brain from the diseased temporal bone, (1) the cerebral abscess most often occurs where the dura is implicated, in cases of disease of the petrous, or mastoid; (2) the dura and brain-substance between the diseased bone and the abscess are generally diseased; in only 6 out of 90 cases was the intermediate brain-substance normal. More careful observation may show more cases of direct extension of the suppuration from the diseased bone than is now thought to be the case. Otto Korner (Archiv f. Ohrenheilkunde, vol. xxix, '90).

Next most common cause of brain-abscess is trauma of the face or skull. Practically all cases occurring in very young children are due to one of these two causes.

Literature of '96-'97-'98.

Study of 32 cases, 13 of which were in children under one year of age, 9 of these being under six months and 5 under three months; 3 occurred during the second year, and 5 each in the third, fourth, and sixth years, no case being included in which the patient was five years old or over.

Conclusions: 1. Abscess of the brain in children under five years is rare.

2. The principal causes are otitis and traumatism.

3. It rarely follows acute otitis, but most often neglected cases, and is usually secondary to disease of the petrous bone.

4. In the cases occurring in infancy without evident cause, the source of infection is probably the ears, even though there is no discharge.

5. The development of abscess after injury to the head without fracture of the skull is extremely rare. In nearly all the traumatic cases definite cerebral symptoms show themselves within the first two weeks after the injury. In cases with falls as remote as several months, there is probably some other cause, such as a latent otitis. L. E. Holt (Archives of Pediatrics, Mar., '98).

Among adults surgical diseases of the ethmoid bone, the orbit, the antrum, necrosis of the maxillary bones and

sometimes caries of the teeth, disease of the frontal sinus, and pyogenic affections of the nose and throat are occasional sources of intracranial pus-infection. Several cases have occurred as complications in erysipelas of the face or scalp. Suppurative adenitis of the cervical glands is another well-known source of infection. Pus-accumulations anywhere in the system—even in remote localities, as the liver, the lungs, the Fallopian tubes, etc.—may, by circulatory metastasis, be attended with a complicating cerebral abscess.

Sudden death of a soldier who was considered to be in perfect health, the autopsy showing a multiple abscess of the left frontal lobe. The man, at the time of his death, was reclining on a bench, reading a newspaper. A few weeks previously he had received a gunshot flesh-wound of the arm, in an engagement with robbers, which had healed readily, the bone not having been injured. The abscess was evidently secondary to the injury of the arm, though not a single symptom—mental or physical—suggested its presence. Surgeon Turner, U. S. A. (N. Y. Med. Jour., Mar. 14, '91).

The brain may be, and often is, attacked in general pyæmia and septicæmia, and tuberculosis and syphilis affecting the encephalon may present the local conditions of abscess. Various constitutional diseases of infectious origin, among which may be mentioned smallpox, typhus and typhoid fevers, grippe, and cerebrospinal meningitis are occasionally complicated with brain-abscess.

Case of multiple cerebral abscess, the separate pus-cavities numbering as many as half a dozen or more and variously located in white and gray matter. The origin of the pus was in a suppurating bronchial gland, secondary to pneumonia,—a source of cerebral abscess in not a few cases, as is attested by statistics. Finley and Adami (Montreal Med. Jour., May, '94).

A rather uncommon medium of purulent brain-infection. Case of general pyæmic infection of the cerebrum secondary to deep-seated abscess of the neck involving the ramus of the jaw. The chief avenue of communication seems to have been through the vessels passing to the cavernous sinus. Oldright (Can. Pract., June, '94).

Three cases of abscess in the right cerebral hemisphere, all occupying nearly the same position in the centrum ovale, all attended with left lateral homonymous hemianopsia, with great weakness of the left arm and leg, the loss of power being greater in the leg than in the arm, the face escaping almost entirely, and with sensory impairment on the left side. The infective material in two was probably derived from distant suppuration, and in one from an injury of the scalp, although the incomplete post-mortem examination renders this uncertain. J. T. Eskridge (Med. News, July 27, '95).

Two cases of metastatic abscess of the brain from primary actinomycosis of the lungs. Both cases were considered clinically to be of tuberculous origin. C. H. Martin (Jour. of Path. and Bact., Nov., '94).

Pathology and Morbid Anatomy.—Brain-abscess is always secondary to the intracranial invasion of pyogenic microorganisms. The growth of such abscess is steadily progressive except when, as occurs occasionally, a membranous wall of tissue develops, inclosing the pus and preventing its encroachments upon surrounding structures; when so surrounded, the abscess is said to be of the incapsulated variety. When incapsulation occurs the further progress of the disease is temporarily and sometimes for long periods of time arrested. The danger of rupture is always present, however, such rupture resulting in sudden apoplectiform symptoms with death, the picture simulating a sudden vascular lesion. In its incipiency brain-abscess presents the local appearance of what

has been termed "acute, red softening." Later the pus changes from a reddish-yellow to a greenish or greenish-yellow color, and is at times quite offensive in odor when exposed. The complications usually found are sinus- phlebitis and thrombosis (lateral and superior petrosal), leptomeningitis, extensive meningo-encephalitis, and purulent pachymeningitis. Leptomeningitis and sinus-thrombosis are especially common in cases due to aural disease.

Charcot and Leyden crystals found in pus from cerebral abscess. These crystals have been found in the expectoration of asthmatics, the fæces of anæmics, from the *Anchylostomum duodenale*, in the semen, in bone-marrow, and in other conditions. So far, they seem to have no constant significance. Campbell (Med. Chronicle, Feb., '94).

The streptothrix found in a case of abscess of the brain characterized during life by epileptiform attacks. This streptothrix developed well in different culture-media, though only completely on potato. In the primary pus and in the potato culture it presented the form of ramifying filaments with knob-like terminations. It stained well by Gram's method. Inoculated into the guinea-pig it did not prove pathogenic. Inoculation into a rabbit caused diffusion of the parasite in the organism without phenomena of reaction or of pseudotuberculosis. Ch. Féré and Faguet (Le Bull. Méd., Aug. 25, '95).

Case of brain-abscess in which the contents, as tested microscopically by cultures and by inoculations, appeared to be absolutely sterile. Careful study revealed no infectious origin in this case, but the abscess might have had an aural or a sinusal origin which itself disappeared and later the microbes exhausted themselves in the slow development of the abscess. Brouardel and Josué (Gaz. des Hôp., Apr. 2, '95).

Literature of '96 and '97.

Infection may spread from the tympanic cavity in four directions: (1) upward through the vault, (2) outward through the external table of the process, (3) downward mainly through the lower wall of the mastoid cells, and (4) backward along the groove of the mastoid sinus. Infection spreads, not only through necrotic perforations, but also along the lymph- and blood- vessels of the osseous canaliculi. An unusual mode is through the groove of the transverse sinus and the foramen lacerum posterius. Quervain (Sem. Méd., Aug. 20, '97).

Case of neglected middle-ear disease in which a large necrotic focus was found immediately beneath the groove for the attachment of the tentorium, midway between the hiatus Fallopii and the aqueductus vestibuli, communicating with a focus in the left side of the cerebellum. Bacteriological and histological examination revealed the staphylococcus pyogenes albus, staphylococcus cereus flavus, and the bacterium vulgare (proteus vulgaris). A. P. Ohlmacher (Cincinnati Lancet-Clinic, Sept. 4, '97).

Prognosis. — Brain-abscess is almost always, if not always, inevitably fatal if treated otherwise than surgically. The duration is variable. The acute cases generally terminate within a week or ten days in death. The slow incapsulated variety may extend over months and even years, the patient dying finally from exhaustion or perhaps suddenly from rupture of the abscess-sac.

Analysis of 169 cases in which pus in some form was present in the brain; only 11 recoveries occurred, all of which were operative cases. In 10 other cases the pus was evacuated, either by operation or spontaneously. Every case not operated upon died, while more than 50 per cent. of those in which the skull was trephined recovered. This emphasizes forcibly the imperative necessity for operative interference in all cases of cerebral abscess. Frank Allport (Jour. Amer. Med. Assoc., Oct. 22 to Dec. 24, '92).

Case of a boy, aged 18, who fell on the back of his head on the pavement;

he had headaches, and on the fifteenth day a severe chill. When seen, eleven days later, he was very ill, with a temperature of 103.4° F.; four days after that the left side of the face and the left arm became paralyzed and insensitive; the temperature then fell to 99.4° F., but the next day he had a rigor and a convulsive seizure beginning in the left side of the face. Trephining was performed over the lowest third of the fissure of Rolando, and an abscess opened beneath the cortex of the lower end of the ascending frontal convolution. Recovery was rapid, power returning to the muscles of the upper extremity from above downward. It may be noted that, on the twelfth day, the urine was found charged with blood and micrococci: a condition which gradually passed off. Nason (Birmingham Med. Rev., June, '91).

Literature of '96 and '97.

The prognosis of cerebral abscess due to ear disease after operation is not as good as might be expected, because these abscesses are not infrequently multiple (20 per cent.) and on account of the difficulty in making a correct diagnosis. A number of these abscesses run a latent course. Occasionally the symptoms are few and of a passing character. Again, the patient is sometimes seen in the last stages of the disease, when the abscess has burst through to the surface of the brain or into the ventricles. Even when the patient has been under observation in hospitals diagnostic mistakes are possible. When the abscess is accompanied by other intracranial complications a correct diagnosis may be out of the question. Grunert (Berl. klin. Woch., Dec., '96).

Treatment.—Every case of brain-abscess should be operated upon and the pus evacuated just as soon as the diagnosis can be made. In no department of brain-surgery have results been so brilliantly successful. In a great majority of cases the abscess is easily accessible and can be readily reached. The surgeon should not wait for coma or grave symptoms of irritation or pressure, but should enter the cranial cavity, at least in an exploratory way, as soon as it seems probable that cerebral symptoms in a given case point to abscess-formation.

In trephining after traumatic brain affection it is advisable to distinguish late and early cerebral abscess. The late abscess apparently does not arise in the contused part itself, but in a healthy one, just like non-traumatic abscesses after traumatic suppuration in the bones and soft parts. These late abscesses generally lie deep, and are covered by normal cerebral cortex. The early abscesses usually arise in the injured area, into which infective material penetrates from without. Fatal meningitis is often associated with immediate suppuration. If the suppurative process is slower, however, and the wound in the brain small, adhesions of the cerebral membranes take place in the region of the injury, and abscesses may result. These abscesses are, to a certain extent, the result of retention of pus in the nests and sacs of a deep wound, and are generally superficial and cortical. They do not develop before two weeks. Very early onset of paralysis or symptoms of irritation are rather signs of meningitis, while the late appearance of symptoms points rather to abscess. (Nasse.)

See also LOCALIZATION.

Cerebral abscess should always be operated on, the diagnosis being easy when the etiology is carefully considered. Inflammation of the middle ear is in nearly all cases the factor, the abscess being usually situated in the temporal lobe; and here the operation should always begin with the tegmen tympani, as well as in the case of suppurative thrombosis of the sinus. As exploratory puncture should first be made, and, if pus be found, the opening should be enlarged, the pus removed, and the cavity filled with iodoform gauze. In cases of

increased cerebral pressure I would advise trephining also, in preference to puncture, the effects of which are only temporary. Von Bergmann (Inter. klin. Rund., June 23, '95).

The chief infectious foci are formed in connection with middle-ear disease. Abscesses of the brain coming from this source are generally in direct contact with the seat of the middle-ear disease. Such abscesses are usually reached most easily through the mastoid antrum. The latter is best reached by an incision through the supramental triangle, by which means the whole tegmen antri and tegmen tympani may be exposed. The whole infectious tract must be removed, after which the skull should be trephined over the temporo-sphenoidal lobe of the brain. McEwen (Med. Rec., May 5, '94).

In every case of cerebral abscess following otitis media the surgeon can, with one skin-flap and with one trephine-hole, explore both the temporo-sphenoidal lobe and the cerebellum. It should be laid down as a rule that in all these cases the surgeon must be prepared, before commencing the operation, to search, if necessary, both above and below the tentorium. If the pin of the trephine be placed one inch behind and a quarter of an inch above the external auditory meatus, a part of the lateral sinus and the dura mater just above it are exposed. After slightly enlarging the hole upward with a pair of Hoffman's forceps, the dura mater can be incised and an exploration of the temporo-sphenoidal lobe satisfactorily carried out. If the pus be not found, the trephine-hole can be enlarged for about one-third of an inch downward and backward, exposing the whole diameter of the lateral sinus and the dura mater for a small extent below it. By incising the dura mater below the lateral sinus, the cerebellum can be easily explored within five minutes of exploring the temporo-sphenoidal lobe. If, after exposing the brain, evidence of meningitis be present and no pus can be found, the lateral ventricles should be tapped by inserting the trocar inward and slightly upward just above the lateral sinus. It is evident that the only satisfactory way of relieving the pressure caused by the inflammatory effusion of meningitis is to drain the lateral ventricles. By this operation the lateral sinus can be easily examined. An exploring-needle connected with an aspirator—or, better, a hydrocele-trocar—can be inserted into the sinus. If blood flow freely from the trocar, thrombosis of the lateral sinus can be excluded. Dean (Brit. Med. Jour., July 30, '92).

Out of eighty-seven cases of trephining for otitis, only in one was a cerebral abscess present. As to the treatment of intercranial pus of otitic origin, it is good surgery to trephine the mastoid process and to wait and see if the symptoms persist, as it not infrequently happens that, under the influence of local and medical treatment, the patient gets well. Broca (Med. Press and Circular, Jan. 9, '95).

Case of double mastoid abscess with septic thrombosis of the left lateral sinus. The left mastoid cells were opened and the contents cleared out, the lateral sinus laid bare and found to contain pus and breaking-down clot; this was scraped away until free hæmorrhage from the upper end of the sinus took place. This was plugged with antiseptic wax. The right mastoid was opened and pus and *débris* removed. The recovery was uneventful. Secker Walker (Brit. Med. Jour., Nov. 17, '94).

Case where the mastoid was trephined when the patient was almost comatose. The bone was eburnated, but there was neither cellule nor pus found. A drain was placed in position, and the patient made a satisfactory recovery. Moure (Le Semaine Méd., Apr. 27, '92).

Case of intracranial abscess, following upon suppuration of the middle ear, successfully operated upon. The patient was a man aged 39; the illness began with a severe cold; when seen, he had a temperature of 102° F. (38.9° C.), and was semicomatose; he remained so for six days, his urine and fæces being passed involuntarily. On opening into the posterior part of the squamous portion of the temporal bone, an incision into the dura give exit to about 3 ounces (90 grammes) of thin pus; no bare bone

could be felt. He gradually recovered, irrigation of the cavity being occasionally necessary. His mental condition during this period was curious: his memory was gone, and he miscalled objects; he could not read, and found difficulty in doing so even after all his other symptoms had disappeared, except some feebleness and uncertainty in walking. It may be noted that, in this case, the chisel was employed instead of the trephine in perforating the skull. Stimson (N. Y. Med. Jour., May 30, '91).

Details of sixty-seven mastoid operations. Most of them were done in the usual method of Schwartze, but the later cases, to the number of about a dozen, were done by Stacke's method of dissecting off the auricle and soft tissues of the canal and laying them forward, chiseling away the posterior bony wall and anterior wall of the attic, so as to throw meatus, attic, antrum, and tympanum proper into one open and visible cavity, then replacing the soft parts and transplanting a flap of canal-lining into the antrum. In these methods radical removal of all diseased structures is attempted, yet in such an open manner as to rob the operation of many of its gravest dangers; important structures can be more surely avoided, healing is likely to be greatly expedited, and the recovery should be secured with a condition far less likely to relapse into cholesteatoma or other renewed troubles. Panse (Therap. Gaz., Apr. 15, '92).

Case in a boy, aged 15, in a state of coma; his pulse was 60, his temperature was 102° F. (38.9° C.), his pupils were dilated. Trephining was performed through necrosed bone, a small amount of pus escaping. Puncture of the brain in various directions detected no pus in its substance. Complete recovery ensued. Dodge (Inter. Jour. of Surg., Apr., '91).

1. When trephining is followed by real improvement, and then by cerebral symptoms without localizing phenomena in the cerebral hemispheres, pus should be sought for in the cerebellum. 2. The incision should be made behind in such cases, for, while apparently involving the lateral sinus, a fibrinous clot will probably prevent too great hæmorrhage. 3. The incision should also be made downward, as, the patient being in the dorsal decubitus, the cerebellum is placed in such a position as to prevent a free flow of pus. L. Monnier (La Presse Méd., Nov. 6, '95).

In opening the skull for cerebral abscess the surgeon need not be always anxious about replanting the bone removed, considering that in three cases the gaps, without replantation, were soundly filled up,—more so than in some cases in which the replantation had been practiced. In order to drain the septic abscesses replantation had been impracticable, but the result was, nevertheless, a sound restoration of the bony case. Rushton Parker (Liverpool Medico-Chir. Jour., Jan., '95).

Literature of '96-'97-'98.

At the present time it is possible to reach, and to deal successfully with, the following conditions: 1. Abscess in the cerebrum, especially in the temporo-sphenoidal lobe. 2. Abscess in the cerebellum. 3. Purulent formations at the base of the skull: (*a*) extradural abscess; (*b*) subdural abscess. 4. Infective thrombosis of the sigmoid sinus, even when secondary foci may exist.

In all these conditions it is essential to explore the cavities of the middle ear by removing the outer wall of the antrum. The partitions of the roof and sigmoid groove separating the middle ear from the temporo-sphenoidal lobe above and from the sigmoid sinus behind are the two great pathways by which infective matter effects its entrance into the interior of the cranium.

In operating, the path of invasion should be systematically followed up, and this may be done with safety and with efficiency by means of the rotary burr propelled by a dental engine. Thomas Barr (Archives of Otology, vol. xxiv, Nos. 3 and 4).

Case of abscess of the temporo-sphenoidal lobe opened and drained through the osseous auditory meatus.

The advantages of this method of operating are obvious: In the first place, we get good and efficient drainage from

below. The drainage-tube can, if necessary, be kept in position for months without any discomfort. It can easily be removed and replaced, and there is no danger of not again finding the abscess-cavity. We can also at the same time efficiently treat and cure the attic and mastoid cells, which in these cases are nearly always affected, and thus prevent any recurrence of the disease. Only one incision and only one operation are necessary. The operation and after-treatment are more difficult and tedious than in the ordinary method of trephining, but the results are certainly more satisfactory. Adolph Bronner (Brit. Med. Jour., Aug. 21, '97).

In children a study of thirty-two cases, no case being included in which the patient was five years old or over, led to the conclusion: that on account of the great amount of shock attending brain-surgery in very young children, an operation should not be urged unless definite localizing symptoms are present, the principal one being hemiplegia. L. E. Holt (Archives of Pediatrics, Mar., '98).

In cerebral operations a large area of the skull should be removed. It both enables us to examine the brain better when exposed, and also, if benefit is to be obtained from relief of cerebral pressure, it surely increases that chance; and also it scarcely increases the danger of the operation. E. D. Fisher (N. Y. Med. Jour., Apr. 16, '98).

Wm. Broaddus Pritchard,
New York.

CEREBRAL HÆMORRHAGE.

Definition. — Under this head are classed all cases where there is an effusion of blood due to the rupture of some vessel within the substance of the brain proper or in the pia. This hæmorrhage usually starts in the brain, but may force its way out and become subarachnoidal or ventricular. Except in case of accidents, it rarely makes its way into the subdural space.

The dural system of arteries is quite distinct, and bleeding from this source should be considered separately.

Simple tingeing of fluids about the brain, not coming from any blood-focus, does not constitute a cerebral hæmorrhage in the strict sense.

Varieties.—It is customary to classify these cases according to the part of the brain that is the seat of the hæmorrhage as cortical, subcortical, or of the central ganglia; frontal, or of either lobe, pontile, cerebellar, etc. Besides the above, however, there are several subforms, as:—

Ingravescent.—This is a term applied to large effusions developing slowly,—*i.e.*, for a period of several hours or for a day or two. This form is largely observed in hæmorrhage at the external capsule; the peculiarity is owed, first, to rupture of a large perforating artery that passes up at this point, and, secondly, to the parallel course of the nerve-fibres in this tract whereby they continue to separate as the pressure increases.

Symmetrical. — Here there is a double hæmorrhage, starting from corresponding points of the two hemispheres.

Meningeal and Ventricular. — These forms may either start as such—though rarely—or they may start from vessels in the brain-substance and then rupture through into one or the other of these spaces.

Traumatic.—Due to violence or injury, in contradistinction to the general run of spontaneous cases.

Punctate and Capillary.—These are sufficiently explained by the terms. Of themselves they are rarely of sufficient moment to be of other than pathological interest.

Symptoms.—Prodromata.—The so-

called premonitory symptoms include headache, dizziness, pallor or flushing of the face, fullness in the head, flickering before the eyes, visual obscuration, poor sleep, tinnitus aurium, thickness of the tongue, numbness or peculiar tinglings of one side of the body, heaviness of extremities, slight mental changes,—as lapses of memory, drowsiness, and irritability,—changed, slowed, or intermittent pulse, etc. These, when occurring in an elderly person, are thought by many physicians to point to an impending hæmorrhage. There is no doubt that such symptoms frequently precede thrombosis. This fact, together with the lack of adequate pathological proof and inability to account for premonitions in hæmorrhage, has caused a disinclination among conservative observers to recognize any connection of the kind. In some cases, however, there may be a preliminary oozing sufficient to produce slight symptoms. Further the evidence of a vasomotor influence suggests that a local paralysis of vessels with sufficient dilatation to irritate the adjacent tracts may precede the actual rupture. This, however, in a few days ends in a frank attack of apoplexy. In the aged most of these symptoms point rather to thrombosis; but in earlier years they may give warning of incipient hæmorrhage.

Constipation is common in the prodromal stage, but is too usual a matter to have any diagnostic significance. Turgidity of the vessels of the head, severe pain in the head, convulsive twitchings of an extremity (Jacksonian), unilateral chorea, etc., are rare, and belong to the initial stage of apoplexy—or, of course, more often its later stages.

Onset.—The symptoms that may mark the onset of the attack include the various prodromata just mentioned; also faintness or general prostration, convulsive movements, aphasia, paralysis, stupor and even unconsciousness, free perspiration; slow, tense pulse, etc.

The regularity and the sequence with which these appear are very variable. In fulminant attacks the severest symptoms may promptly develop, and even death itself be not long delayed. Sudden death may occur if the trouble is in the pons. Oftener there is a gradual increase, both in the number and the seseverity of the manifestations, for some little time: one, two, three, or more hours.

Headache.—Very often there is no special complaint of pain in the head, and again headache has been such an habitual thing with the patient that little importance can be attached to it. Nephritic complications, when present, tend also to rob this symptom of value.

In many cases, however, there is headache, severe, deep, and general in character, less often localized. It becomes more pronounced as the effusion increases in volume, and, even when the consciousness has become more or less obscured, the sufferer may persist in putting a hand to the head, evidently because some degree of pain or distress is still perceived. When, therefore, we meet a headache unusual to the patient, excruciating in character, not otherwise explicable, and associated with suggestive phenomena, it acquires some value as a symptom.

A low, occipital pain is common in cases of cerebellar apoplexy; but as it may be due to other causes its only significance comes from association.

Vomiting.—This is a common symptom and one of much clinical importance, its value, however, depending much on the certainty with which uræmia can be excluded. Nausea may,

of course, attend dizziness, faintness, or thrombosis; but actual vomiting, aside from uræmia (especially if the person is reclining), argues, in a suspicious case, for hæmorrhage. This applies to the increasing period of the effusion.

[It has been claimed to be especially frequent in cerebellar hæmorrhage, but, as stated, it is common in all forms. W. Browning.]

Where the latter is at all voluminous, in almost any part of the brain we see vomiting, often severe and even somewhat prolonged. Its occurrence depends upon the volume of the effusion, the speed with which it is poured out, and to some extent upon its location. In the slower, or ingravescent, forms, even though they finally reach a large size, there is less tendency to emesis. It is where we find other evidence of an apoplectic seizure that this symptom acquires value; then it also assists materially in differentiating the nature of the brain-process.

Nearly always some other plausible explanation is proffered: the person has just eaten overheartily, been lying in a cramped position, had an hypodermic, taken medicine that upset the stomach, or been suffering from gastric catarrh. The diagnostician must, of course, be able to discount such suggestions.

Yawning and Sighing. — These are very frequent and striking symptoms in hæmorrhage, and are often more marked if the patient is in a sitting position. There is a slight parallelism between them and the vomiting. But as they are also common in cases of thrombosis and may occur in embolism while there is a badly damaged heart, they have only a limited diagnostic value. In cases of hæmorrhage these manifestations suggest that the focus has already reached a sufficient size to produce some degree of brain-anæmia.

Coma and Other Disturbances of Consciousness.—These are of great importance for both the positive and the differential diagnosis. But at the same time they are matters most difficult to describe or define with exactness and in accordance with the facts.

Coma is a state of profound unconsciousness not due to sleep, syncope, or drugs. But in practice we meet all kinds and degrees of disturbance of consciousness. The eyes may be open and staring, yet the person fail to make any responses to our interrogations and evidently fail to have any understanding of language or surroundings. More often there is a condition of stupor that admits of but partial and temporary recognition. We can then conveniently distinguish coma, stupor (a partial coma: "semicomatose"), and dazed conditions.

The duration of these states is next in importance. They may be of such transitory nature as to pass unnoticed, or they may last several hours or days, the lighter degrees being, of course, as a rule, of shorter duration. The time in the attack when coma supervenes is also to be noted; if at the start it may be partly a direct shock-effect; if later and more gradual it indicates that the effusion has reached a large volume.

The size of the output requisite to produce this symptom varies much with its location. A small clot in the pons, for instance, will produce a much deeper impression on consciousness than one of far-greater size in the pallium. Wernicke and others have sought to explain this by the smaller size of the vessels, their indirect course, and hence slower leakage in the hemispheres. But this view is negated by several facts, how-

ever well it may explain the favorite sites of hæmorrhage.

[A competent medical friend offers the following more scholarly definition: "Coma is a condition of profound unconsciousness, the result of injury, disease, or some form of intoxication." But the sleep of chloral or morphine is not termed coma, while, on the other hand, that of alcoholism often is. Neither is true coma always so profound. In fact, there seems to be a considerable latitude in the use of this term.

Perhaps the above definition might be modified as follows: Coma is a state of unconsciousness due to some other cause than sleep or syncope. The effects of intoxications, soporifics, or anæsthetics should only be called coma when the person can no longer be roused to consciousness. W. BROWNING.]

The comparison of a large number of these cases shows that involvement of the sensory tracts has little or no influence on consciousness, while other cases with equal-sized foci involving certain parts of the motor path show, as a rule, very marked impairment of consciousness. From a psychological stand-point this seemingly anomalous fact agrees with conclusions based on other evidence. But it is cited here to prove that much depends on the part involved as to the effect on consciousness.

A close analogy can also be drawn with cases of embolism. The writer has shown that embolism involving only parts above the basal ganglia does not cause coma. Inasmuch as in many of these cases a large patch of brain-tissue is involved, and as, further, the suddenness of the attack must be equal, whatever the part involved, it follows that here again much must depend on the particular structures included, for smaller infarctions, if only they involve the ganglia, often do bring on coma.

It can consequently be stated that, whatever accessory influences there may be, there are but two important governing factors in the development of coma: the size of the hæmorrhage and the particular part of the brain implicated. These deserve a little further consideration.

As to the amount of hæmorrhage that will of itself cause coma, experiments on animals by Pagenstecher, von Schulten, and others have led to the conclusion that in the human being one and a half to two ounces is about the extent of limitation of the brain-space that can be borne without interruption of psychical functions. (More can be tolerated in a diffuse effusion like a meningeal hæmorrhage than in a confined focus.) The exact amount thrown out in a case of apoplexy is rarely, if ever, known, since some of the fluid is promptly absorbed or scattered, and, independent of that, it is impossible to more than estimate the volume of these irregular foci. So far as such rough estimation goes, it corresponds fairly with the experimental results. This applies to cases in the hemispheres (pallium). When the size of an effusion is stated to be that of a hen's egg, it may be considered to equal two ounces of fluid. Hence, hæmorrhage of that bulk should be, and in practice is found to be, on the borderline. It may be expected to at least produce stupor and frequently some coma. When of greater volume, coma very generally results. In the basal ganglia, however, a much smaller amount may suffice.

The principle here is that the effusion, by its volume, exerts such a general pressure on the whole cortex as to obtund consciousness. Of the sufficiency of this factor there is no question. It may act by producing an anæmia or by more direct mechanical effect. Further, a compression, before ineffective, may be-

come sufficient if the arterial pressure sinks.

As to the susceptibility of different parts, injury below the oblongata (*i.e.*, in the cord) does not cause coma. The syncope of shock or even sudden death may result, but not real coma. And it is uncertain whether hæmorrhage of the oblongata has much tendency to produce coma; most such cases are small and any stupor is masked by respiratory and other phenomena. In the old case of Fabre (quoted by Gintrac and others) some loss of consciousness attended a small hæmorrhage of the left pyramidal body. But in several other cases of small effusion in other parts of the oblongata no distinctly comatose condition has developed.

At the other brain-pole—*i.e.*, corticad of the central ganglia—we have already seen that coma is essentially a consequence of general brain-compression. In this major portion of the encephalon there is little difference between the various parts. Apparently the occipital lobe tolerates infringement better than the frontal and parietal lobes; but there is no decisive difference.

Regarding the cerebellum, the general opinion agrees with the evidence that uncomplicated hæmorrhage when moderate in amount does not invoke coma. But in these rather rare cases either rupture occurs or, if much size is attained, there is so much pressure on subjacent structures as to obscure the bearing of the case.

There still remains the region of the central ganglia, the cerebral crura, and the pons. Hæmorrhage of the caudate nucleus is prone to bring on coma. That in the lenticular nuclei and in the thalami is somewhat less apt to do so. When in a cerebral crus, there is commonly some coma or, at least, stupor, though these hæmorrhages are rarely voluminous. Those of the pons are most inclined to cause coma, though usually small unless they have already ruptured. A comparison of this last group of cases (involving the brain-stem) brings out forcibly one fact already referred to,—viz.: that hæmorrhages in the sensory path show but little tendency to cause coma, while those in the motor path have a marked tendency in that direction. This fact stands out quite as clearly when they are compared by volume. It is, of course, not certain whether this applies specially to the motor tract or to other and less understood tracts closely associated with them; it may be fibres to the so-called somæsthetic area. So far as this coma-zone has been noticed in the past, it has been thought to depend upon the fact that here were grouped fibres passing to, and thus influencing all parts of, the brain.

Secondary Factors in the Causation of Coma.—There are, of course, various other influences that affect this result. The person's susceptibility is one; carbonic-acid poisoning due to superficial respiration is another. But most important of these is the rapidity with which the effusion occurs. On the experimental side it is well known that the effect on consciousness depends somewhat on the rapidity with which the compression is produced. But it is rare in clinical work to meet cases where a hæmorrhage has taken place with any such rapidity as in the average experiment. As Liddel long ago pointed out, considerable time is taken up before the bleeding stops. We also know that in the slow, ingravescent form, though a day or two elapse in the process, coma just as certainly supervenes when the volume of the focus becomes adequate.

The disappearance of coma is attrib-

uted to a re-establishment of the circulatory balance, to reduction of pressure from lessened cerebrospinal fluid, and perhaps a gradual tolerance to the focus. The shock-effect passes off, and some of the fluid of the focus is absorbed.

Aphasia.—This symptom, of itself and without corroborative manifestation, is rarely indicative of cerebral hæmorrhage. A considerable majority of all cases of aphasia are due to other causes (see article on APHASIA, vol. i). These are mostly transient forms lasting from a few hours to a few days and embracing all degrees of speech-impairment up to its complete loss. They are occasioned by gout, uræmia, and less frequently other toxic conditions. Possibly the standard writers do not take sufficient notice of these transient forms. Even of the more lasting cases a certain number will be due to thrombosis, embolism, etc.

Only in a part of the cases of cerebral hæmorrhage do aphasic symptoms appear. To produce these the speech-tract must either be directly injured by the effusion or indirectly implicated by pressure. This, of course, only occurs when, in right-handed persons, the lesion is on the left hemisphere, and in left-handed in the right hemisphere. Apparent exceptions to this rule occur as in a recent case (of embolism) where an originally-left-handed youth had so trained himself that he passed for a right-handed person.

All degrees and forms of aphasia occur in association with hæmorrhagic apoplexy. Where it is due to implication and not to direct involvement of the speech-centre or tract, then recovery from this symptom may occur, the time required and the extent of recovery being dependent on the circumstances of the case. By speech-centre we, of course, mean not only the motor centre in Broca's convolution, but also the hearing-centre and other associated parts. Inasmuch as all forms of aphasia and paraphasia are involved, it is not practicable to enter on a discussion of them here.

Convulsions, Twitchings, etc.—Rarely a few spasmodic twitches occur during the onset-period in the territory where paralysis is developing. These may not be noticed unless in the face. It is not certain that they point to a cortical focus.

Quite distinct from these are the unilateral clonic convulsions (Jacksonian type) that occur in the rare cases of effusion about the cortical motor area. Such cases are far oftener of traumatic than of spontaneous origin.

Of course, uræmic convulsions may bring on or accompany an apoplectic seizure, though this is unusual. Otherwise general convulsions in this condition point strongly to ventricular hæmorrhage or to rupture into the lateral ventricles.

> [They also are not rare in thrombosis, and in both meningeal and frontal hæmorrhages. W. BROWNING.]

Even in case of such rupture, however, convulsions do not always follow; nor does slight oozing, as in many cases of impending rupture, have this effect. When such convulsions do occur, they may be of the severest character that we ever witness. In any case, such complications give a very bad outlook, for ventricular rupture is only more certainly and rapidly fatal than uræmia. Rigidity of the paralyzed or even both sides is also frequent in ventricular rupture.

Paralysis ; Respiratory Paresis.—This is one of the commonest as well as most

striking and characteristic symptoms, although not a necessary accompaniment. It may affect either motion or sensation or both.

The time of the attack at which it develops depends on the location and the rapidity of development of the effusion. Usually it appears with the onset of the seizure, though at first frequently but a mild degree of paresis; in such a case we can conclude that, as yet, the motor path is only suffering from pressure. In occasional cases the paralysis is not manifest until later or becomes pronounced only in the reaction-stage; but it is then difficult to distinguish from an increasing effusion.

Motor involvement constitutes the most marked and important manifestation of average cases, and when present may range all the way from the slightest degree of weakness up to complete flaccidity. While any of the voluntary muscles may suffer, certain prevalent types can be made out. Monoplegias and more limited paralyses, running as such from the start, occur in some of the rare cases of hæmorrhage corticad of the internal capsule. When this is in the occipital, frontal, or temporal lobes, there may be no definite paralysis unless the focus becomes so large that the transmitted pressure affects the motor neurons. But, as the great majority occur in the basal ganglia or pons, the hemiplegic type is by far the most common. Of this there are two distinct forms: the one of simple hemiplegia, where all the affected parts are on one side (arm, leg, and face, all or in part), and the other of crossed hemiplegia, where an arm-and-leg paralysis on one side is associated with some involvement of the cranial motor tracts on the other side. This latter form is typical of localization in the pons, because of the fact that the cranial tracts have already decussated, while the first form is that due to the common site in the basal ganglia. In the very rare cases of bleeding in a cerebral crus, there may be a special form of crossed paralysis: involvement of the arm and leg on the side opposite the lesion and oculomotor paralysis on the same side, due to the intimate relationship of this nerve with the crus.

There is some basis for the view that lesions of the thalamus *may* present a special characteristic. This consists of loss of emotional or pantomimic movements, while the volitional motions are still preserved. This applies specially to the cranial distribution. If, on the contrary, the cranial paralysis is due to lesions more anterior at the same level or higher up there may be a preservation of the so-called mimic, with a loss of voluntary, movement. In practice, hæmorrhages of this region are usually so massive that both grades of motion are equally lost.

It is possible that something of the kind also holds for the extremities, since we sometimes see cases of hemiplegia where, in sleep, the patient is able to lift a hand to the head. Here may also be classed the so-called methemiplegic movements; these are such as occur in a paralyzed part in association with voluntary movements in the corresponding well part.

In ordinary hemiplegia we find the arm and leg motionless or nearly so, a little motion possibly remaining in the fingers or toes. The arm lies helpless by the side or across the chest. The patient, if requested to move it, reaches over with the other hand. The leg stays in almost any position in which it is placed. In the complete form it is impossible for the patient to turn in bed or to rise at all from the recumbent

position. In coma the paralysis may be presumed from the drawn face, expiratory puffing of one cheek, and the heavier, passive drop of the affected arm when lifted and let go.

As a rule, the leg improves faster than the arm, perhaps, as claimed, because the arm-tract is apt to be more involved than the leg, or, perhaps, because the leg-movements (as in walking) are more automatic in character. It is considered an unfavorable omen when, on the contrary, the arm improves faster than the leg. The hypoglossal and facial tracts are more apt to escape direct implication, and the upper facial quite regularly escapes (a point of distinction from like hysterical paralysis).

Sensory loss is also a common though less frequent and lasting accompaniment than motor. In many cases it is so transient that in a few days little trace of it remains. Its occurrence depends on interference with the sensory neurons. Their most exposed point is at the *carrefour sensitif* (posterior border of the internal capsule), where the sensory tracts are more closely grouped than elsewhere in their course. This point is also about opposite the commoner sites of hæmorrhage, though a little to one side, which harmonizes with the fact that permanent loss of sensation is the exception. The most-marked features of this type are loss of common sensation in the opposite half of the body and homonymous hemianopsia (blindness of opposite half of visual field of each eye). Hearing may also be interfered with and sometimes taste and smell, the latter two only on the opposite side. In hæmorrhages involving either the hearing-centre in the first temporal gyre, the visual centre in the cuneus, the other sensory centres, or the paths connecting these with parts below, there will be a correspondingly-limited loss of sensation. In pons lesions the special senses escape, unless occasionally those of hearing or equilibrium. At the same time the tracts for general sensation to the other side of the body may suffer. In cases where there is more lasting anæsthesia it involves deep parts and mucous membranes as well as the surface.

Eye-symptoms. — Pupillary changes have but little value here for purposes of localization. They do, however, serve one important and usually overlooked purpose: the presence of anisocoria (inequality of the pupils) is valuable objective evidence of the existence of some real lesion, and has a bearing on differential diagnosis. Of course, this presupposes the existence of corroborative symptoms and the recent acquisition of the inequality. The possibility of latent anisocoria should be excluded by determining whether the condition persists on full illumination of the two eyes; if, on so testing, the pupils become equal, the inequality can be put down as probably an affair of long-standing or spinal in origin.

Inequality of the pupils may occur in large effusions that by pressure weaken the oculomotor on that side and thus allow that pupil to dilate. It is consequently not rare in cases involving the frontal lobe or basal portions of the cerebrum. In pons troubles anisocoria is common, though both pupils may be large or small according to the degree of third-nerve involvement. In meningeal forms the pupils are often affected, though there is no rule here for our guidance.

Conjugate deviation of the eyes very often points to a lesion on the same side, but this is not an invariable rule.

Diplopia or more distinct evidence of

paralysis of external ocular muscles is unusual except in comatose conditions. Its interpretation depends on the individual case.

Ophthalmoscopical changes are not sufficiently marked in the early stages to be of any value, nor are they often much more so in the later. After development of the full apoplectic state there may be some choking of the retinal veins, especially on the side of the lesion. Miliary aneurisms have been observed in the retina, but are quite unusual. Hæmorrhages of the retina may indicate nephritis; but only to that extent suggest the cause of any cerebral condition.

Bowels.—Constipation frequently precedes or accompanies the attack. Or, on the contrary, where there is deep unconsciousness or prolonged stupor, and especially if drastic purgatives are given, involuntary discharges may occur. Their chief importance lies in the necessity, then, of scrupulous care lest eczema and bed-sores develop, and in the commentary they offer on the state of consciousness or the possibility of dementia.

Urine.—At the onset the urine is usually acid. Transient glycosuria is a possible accompaniment of hæmorrhage in any part of the brain. The sugar usually disappears from the urine in from a few hours to a couple of days. Presumably it originates from shock to the so-called sugar-centre. When this spot in the floor of the fourth ventricle is directly involved, the sugar may persist longer, though it usually subsides, even then, in a week or two.

As a part of the same manifestation there may be a polyuria simply, that is then even more fleeting in character.

Albuminuria is a frequent and more serious accompaniment. Like the preceding symptoms, it may be but transient in character; but its presence is always a cause for anxiety. Many cases of apoplexy are due to Bright's disease, and an examination of the urine, therefore, should be a routine procedure in all cases.

Hemichorea.—This is of rare occurrence. It may either precede the attack (prehemiplegic chorea), though this is unusual where hæmorrhage is the cause, or it may develop during the recovery stage (posthemiplegic). It is thought to be due to irritation either of the motor tracts or else of some band of fibres closely associated with these. It is a symptom of irritation rather than of destruction, and hence is never present where the paralysis is complete. If an inaugural symptom, then it disappears as the paralysis deepens; otherwise it comes on as the paralysis begins to mend, and in turn also disappears as the paralysis wears away. Hence its appearance in convalescence is a good omen, however annoying to the patient. It is not a symptom of the attack itself.

This affection involves strictly one side of the body only. It may take in principally an arm or the lower extremity, but usually involves both more or less. In degree it varies much according to the stage; but is often severe and continuous in character. The type of movements is hardly different from that of ordinary chorea of childhood.

Tendon-reflexes.—At the onset and during the period of development no great changes in the reflexes can be made out, unless diminution. But so soon as the effusion seriously interferes with the motor path and even more after the subsidence of shock the tendon-reflexes of the paralyzed parts show a decided increase; this may apply both to the force of the reflex and to the extent of area from which it is elicitable. In gross lesions the pathological jerks like ankle-

clonus and wrist-clonus may also be demonstrable, either immediately and temporarily, or later on after descending degeneration. It is necessary to compare the two sides to settle the relevancy of the symptom. Even then there are cases in which both knee-jerks are increased from unilateral lesion, in proportion, perhaps, to an incomplete decussation of the pyramidal tracts, as is further shown by the somewhat bilateral paralysis of the lower extremities. As a rule, however, we find a purely-unilateral exaggeration of the tendon-reflexes.

Other Symptoms.—Those pertaining to the period of the seizure are almost described by their enumeration.

A slightly-subnormal temperature (one to two degrees) may frequently be found for an hour or two after the onset. Later an increase of temperature is not unusual. It amounts to but a few degrees at most and is transient in character, lasting only a few hours, as a rule. These variations in temperature are somewhat commensurate with the severity of the seizure. From the experiments of Ott and others it is known that there are so-called heat-centres as far corticad as the caudate nucleus, and it is to disturbance of these that the hyperthermia is doubtless due. It is claimed for pons hæmorrhage that the temperature may rise from the start.

Trouble in swallowing (dysphagia) may be simply an expression of the general weakness, though at times it seems to partake of the nature of a central paralysis. It necessitates extra care lest food slip down the trachea.

The respiration is often affected. Stertorous breathing is an attendant on the deeply-comatose state. In the subsequent weak condition of the severe cases Cheyne-Stokes respiration may appear at any time and is especially prone to do so in the hours of deep sleep. It may also occur in the primary coma.

The subsequent mental condition often shows impairment of intelligence, psychical functions, memory, and mental grasp. These incline to be the greater, the severer the attack. Laughing or crying on inadequate provocation, an anxious haste in carrying out anything planned, and many other aberrations might be cited.

Peripheral Troubles. — *Contractures.*—These may develop some weeks after the attack, and are usually spastic and functional rather than organic. They are associated with great increase of the tendon-reflexes. By a slow, steady counter-pressure complete extension can be effected, but the part quickly becomes flexed again on relaxation. This condition means little else than that the corresponding fibres of the pyramidal tract are involved. Separate from this is the early rigidity due to stimulation of the motor tracts by the irritative lesion.

Œdema.—This condition of the paralyzed part is not of very frequent occurrence. It has been thought to be due to degeneration of the pyramidal tract, but it sometimes develops so early after the apoplectic seizure that the neural change could hardly have taken place. The amount of swelling may be little or much, and changes readily with the position of the patient. It collects at the most dependent part of the extremity.

Neuritis.—Occasionally a degenerative neuritis develops in the affected area. Considerable pain may be associated with it, though this must not be confused with the muscular tenderness that often follows directly on the paralysis. The reason for the occurrence of

this form of neuritis is not well understood. Possibly it is an outside process grafted on such nerve-fibres as have least resistance.

Decubitus.—This is not, as a rule, as liable to occur or as resistant as in disorders directly involving the peripheral neurons. Still, from the inability of the paralyzed patient to relieve pressure on prominent parts, from the maceration by the discharges when not scrupulously cared for, and from the frequently impaired sensation, it is very easy for bedsores to develop.

Trophic changes are supposed to be due to trouble with the innervation from the peripheral neurons; but Nothnagel and others have adduced some facts indicative of trophic influence from certain parts of the brain. Vasomotor disturbances, lowered arterial tension, etc., are observed on the paralyzed side.

Differential Diagnosis.—This has to be made between hæmorrhage and the following conditions: Embolism, thrombosis (including its precedent conditions, such as syphilitic arteritis), pseudoseizures, certain toxæmias (as uræmia, gout, alcoholism, etc.), simple fainting, hysteria, and sudden death from various causes.

The practice of uniting nearly all of these under the one head of apoplexy is, unfortunately, too common. While our diagnostic methods are not sufficient for all cases, the following principles will usually suffice to differentiate. Good medical judgment is here a strict necessity. To know our patients, their past histories, and any chronic disorders from which they may be suffering is of great advantage.

Embolism.—Against embolism speak: the absence of any distinct mitral or aortic lesion, the presence of headache or other prodromal manifestation; deep coma, especially late development; vomiting, pronounced anisocoria, and advanced age.

Thrombosis. — Against thrombosis speak: youth unless the patient be a syphilitic, coincident or early rise of bodily temperature, early and deep coma, vomiting, great inequality of the pupils, high barometric pressure at time of onset, beginning of attack when the person is under effort or excitement, a pulse of high tension, the absence of prodromata, and the existence of vigorous general health.

Pseudoseizures.—The question of a pseudo-attack can only arise where the subject is also suffering from either progressive dementia, tabes, disseminated sclerosis, or possibly the results of alcoholism.

The other possibilities can be excluded more readily and on general lines.

> A period of consciousness following insensibility produced by violence, then lapsing into coma, is a most important symptom in the diagnosis of middle meningeal hæmorrhage without fracture of skull. W. J. Taylor (Therap. Gaz., Oct. 15, '94).
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> In young girls, especially prolonged unconsciousness may follow concussion, leading to possible diagnosis of graver trouble. Absence of all other symptoms should suggest the possibility of mental state alone. Walton (Amer. Jour. of the Med. Sciences, Apr., '95).
>
> Case in which, at intervals of a few hours during the first day or two, consciousness was regained and entire use of the paralyzed regions for periods of five or ten minutes at a time. R. D. Bibber (Boston Med. and Surg. Jour., Aug. 22, '95).
>
> Brain with hæmorrhage into Broca's convolution and the part between Broca and the internal capsule; posterior part of Broca involved. The symptoms had been almost those of bulbar paralysis. The only other symptom was dilatation of the right pupil, which came on toward

the end. Elder (Edinburgh Med. Jour., Sept., '95).

After an apoplectic attack, with flaccid unilateral hemiplegia, if bilateral contraction of extremities appear, lasting several days, with deviation of head and eyes to hemiplegic side, a diagnosis of capsular hæmorrhage with secondary hæmorrhage of ventricles may be made. Seppilli (Gaz. degli Osp., No. 57, '95).

Case of hæmorrhage into the pons simulating opium poisoning. F. W. Edridge-Green (Brit. Med. Jour., May 11, '95).

Case of cortical hæmorrhage with rupture into the lateral ventricle in which two symptoms were at variance with authoritative statements: 1. Difference of temperature between two axillæ; paralyzed side 1.2° lower. 2. Conjugate deviation of the head and eyes toward the right (the paralyzed) side. Rigidity of arm on paralyzed side present. H. A. Royster (N. Y. Med. Record, Dec. 7, '95).

Literature of '96 and '97.

The absence of glycosuria in a doubtful case is inconclusive, but its presence points to a cerebral hæmorrhage, doubtless accompanied by invasion of the ventricles. M. A. Robin and W. G. Kuss (La Méd. Mod., No. 61, p. 481, '97).

Etiology.—The immediate cause of the hæmorrhage is, of course, the rupture of some vessel, usually an artery, but occasionally a vein. Back of these vascular changes we come to the real causes that interest the practitioner. And here there is a broad distinction between senile conditions and those other factors that may be active at any period of life.

In the young a considerable proportion of the rare cases is due to the rupture of some single large aneurism in the vessels of the pia; as to their etiology, little is known. Except for these and before the advent of senility we find either nephritis, syphilis, local softening, traumatism, abnormal blood-conditions, or possibly certain nervous influences as the predominant causes.

Miliary aneurisms have much less to do with its causation than has previously been held, and, apart from mechanical causes, such as trauma, etc., hæmorrhage of the brain is most frequently due to disease of the vessels that causes a loss of elasticity in their walls. Typical miliary aneurisms are rare, but atheromatous and syphilitic changes of the vascular walls play a very extensive rôle. Mechanical causes are more common than is commonly held to be the case in producing hæmorrhage, without any real arterial disease sufficient of itself to produce it. L. Stein (Deut. Zeit. f. Nervenh., vol. vii, p. 313, '95).

Case in an infant 5 days old. Notwithstanding absence of marked cerebral symptoms, extensive hæmorrhage into the brain, no convulsions or even unconsciousness were present. T. M. Rotch and A. H. Wentworth (Boston Med. and Surg. Jour., Aug. 15, '95).

Two cases of cerebral hæmorrhage in children. The first, aged 13, symptoms of heart disease, dyspnœa, swelling of the feet, and pain over the cardiac region, which had come on about a month previously. Diagnosis was ulcerative endocarditis. Death. Numerous warty vegetations were found at the free edge of the cusps of the mitral valve. Second, 6 ½ years old, died eight days after admission. Illness had begun three weeks before with headache, vomiting, weakness of the legs and arms, and an increasing disinclination to move about. On admission there was decided ptosis of the right side, with paresis of the muscles of the left side of the face; loss of power and some rigidity in the left arm and both legs, the left more than the right; unable to stand without support, pupils equal and reacting to light; she was quite sensible, and complained of severe frontal and vertical headache. Paralysis grew more marked; well-marked double optic neuritis. Post-mortem. Collier (Brit. Med. Jour., Sept. 28, '89).

Case of mixed hæmorrhage and thrombosis secondary to mitral disease in a

child 7 years old. Fox (London Lancet, Jan. 27, '94).

In traumatic cases the violence is a sufficient explanation. As a rule, the hæmorrhage results promptly. But there are now several cases on record showing that several hours or days, even a week or more, may intervene. These are mostly meningeal forms, yet it is certain that some are intracerebral. It is these cases of delayed apoplexy that serve to associate the traumatic with the other varieties.

Case of a child of 5, who fell, striking on her head. She became somnolent, answered questions correctly, but hesitatingly; perfect sensation and muscular co-ordination. Discoloration of all the palpebral and ocular tissues, with sufficient œdema to completely close the right eye; left pupil responded readily to light. Trephining revealed a clot three-sixteenths of an inch in thickness and one inch in diameter, which had formed between the dura mater and the parietal bone. This was evacuated and drained and the child recovered. Ruth (Jour. Amer. Med. Assoc., Feb. 6, '92).

College-student, aged 19, struck in a friendly boxing-bout, upon the left jaw, large gloves being used. Death on the sixth day. No external marks of violence. Left lateral sinus found ruptured. No pathological changes present in the vessel-walls. Walton (Boston Med. and Surg. Jour., Mar. 1, '94).

Nephritis is one of the most certain causes. The arteriosclerosis that develops may later degenerate, allowing the vascular tunics to give way. In any case the heightened blood-pressure and perhaps the circulating toxins so weaken the arterial wall that under some sudden stress it breaks.

Syphilitic alterations of the vascular parietes seem at times to be the immediate cause of their rupture; though this claim needs a better basis than the fact that the patient is a specific or that antisyphilitic remedies produce a good effect. Much more certain are the cases where the break results indirectly. In them a former specific arteritis, that may long since have run its course, has left behind it a cicatricial and hence weakened spot which ever after remains. Like all scar-tissue, this has less resistance and too often in time yields. This point has been strongly urged by Gowers. There are also evidently other cases in which softening of this origin makes the intermediary link to vascular rupture. In neither of these latter forms can specific treatment well have any value; they differ only etiologically from the general run.

Of 100 non-fatal personal cases 36 were due to syphilis; they occurred in early life and were often multiple in character. Cerebral hæmorrhages were rarely repeated. Many cases showed changed vital conditions and personal habits. C. L. Dana (N. Y. Med. Jour., Jan. 5, '95).

Local softening. This may be due to traumatism, embolism, septic infection, syphilis, or whatever other cause. The focus is usually not a large one, and not the cause of any definite symptoms. Even if its presence were known, it is hard to see how anything could be done to remedy it or ward off this particular sequel. The prevention of the softening must depend on the general management of those affections that lead to it.

Abnormal constitutional blood-conditions, such as scorbutus, purpura, pernicious anæmia, leucocythæmia, and severe infections with hæmorrhagic diathesis may act as efficient weakeners of the vessel-parietes. Hæmophilia is not known as a cause, however much it might darken a case.

Nervous influences. The probability of these as a factor was suggested by the writer to explain certain occasional peculiarities, as the onset during sleep,

when the blood-pressure is lowest, the absence of aneurisms as a source of hæmorrhage in many cases, the asserted occurrence of prodromata at times, and especially the occurrence of symmetrical hæmorrhages. It is to the vasomotor control of these parts that such action must be assigned. This principle rests on the close bilateral association of the brain-hemispheres, and presumes that any general influence—as from the abdominal or thoracic viscera, reaching some centre or part of one hemisphere—affects at the same time or in immediate sequence its opposite in like manner. Possibly by allowing a dilatation of the arteries to the respective parts a strain is exerted on the vessels secondary thereto, and thus weak points give way. Whether this cause can of itself be sufficient or whether it at most is only an immediate cause cannot be stated.

Literature of '96 and '97.

Two cases of apoplexy which were considered as hysterical. Trophic lesions, such as œdema and hæmorrhage, as observed elsewhere in the body, may exist in the brain, according to his view. Hysterical hæmatemesis, hæmoptysis, and ecchymosis are well known; there is no reason why similar lesions should not be found within the cranial cavity. There was no autopsy in either of the cases; if there had been, the hysterical nature of a hæmorrhage could not have been demonstrated in this way. Gilles de la Tourette (Bull. et Mémoires de la Soc. des Hôp. de Paris, June 4, '96).

The changes that old age brings are universally recognized as predisposing to apoplexy. This has, in times past, lead to the assumption that cerebral hæmorrhage was only a matter of years. Because senility is added to the other factors this trouble is more frequent in the aged, though it has been found that in the very old cerebral thrombosis is a more frequent result. But, as the previous causes are quite as common in the younger or stress years of life, there is no immunity at any period.

Distinct from the above are the immediate provoking causes, of which there are many: straining at stool, lifting of heavy weights; plethoric states, as after excessive eating; rage, fright, the sexual act or other great excitement, severe coughing, meteorological conditions (rise in barometer, fall in atmospheric temperature), etc., come under this head. These all act by increasing the blood-pressure. Presumably they are, of themselves, insufficient without previous vascular change.

Hereditary influence. Case of a man of 25, who had a bilateral cerebral hæmorrhage, whose father and one brother died of left hemiplegia at 58 and 28 years, respectively, and whose sister died of apoplexy at 25 years. No history of syphilis. Bernard (Bull. de la Soc. Anat., No. 26, '93).

Literature of '96-'97-'98.

Cerebral hæmorrhage in a child, a girl aged 12 years. An extensive intraventricular hæmorrhage had occurred, resulting in rapid death. The patient had enjoyed robust health and had never any serious illness. The family history was good; there was no evidence of syphilis. A few hours before death she complained of headache and vomited several times. She then went to bed, and was found dead two hours later. No convulsions were observed. The left lateral ventricle was found to be filled with blood-clot. The septum lucidum had ruptured, and some blood had passed into the right ventricle and also into the third ventricle. There was no laceration of the basal ganglia, and the bleeding appeared to have been primary in the ventricle. Lea (Brit. Med. Jour., Feb. 6, '97).

Varicella as an etiological factor. Case of a strong and healthy boy, aged 13 years, who had a mild attack of varicella.

At the end of a week he complained of slight headache and photophobia and vomited. He became comatose; the right pupil was widely dilated and the left was contracted. Convulsions set in and he died ten and a half hours after the seizure. The vessels of the dura mater and the pia mater were much congested. The right lateral ventricle was full of blood-clot and the brain-substance was ploughed up in the neighborhood of the temporo-sphenoidal lobe, the hæmorrhage having probably come from the lenticular striate branch of the middle cerebral artery. All the organs, the heart, and the arteries were healthy. Maitland Thompson (Lancet, Apr. 23, '98).

Pathology.—This resolves itself into three questions: (1) as to the vascular changes preceding or attending the rupture, (2) as to the blood thrown out, and (3) as to the changes of nerve-tissue resulting therefrom.

1. In the usual spontaneous cases we find some alteration of the vessel-walls that weakens their resistance. Fatty and atheromatous degeneration is common in the aged, and appears earlier in those who have done heavy lifting, over-indulgence in alcoholics, or for any cause developed premature senility. Nephritis and the uric-acid diathesis lead to arteriofibrosis, which later breaks down. Specific arteritis leaves an atrophic condition of the vascular wall, and this may, in time, yield. Aneurisms (miliary) sometimes develop, as found by Bouchard and Charcot, doubtless on the basis of some of the conditions just mentioned, and presently one or the other of these may give way. Later studies have shown that far from all spontaneous cases are due to the rupture of such aneurisms. We must conclude that weakened spots sometimes give way directly; *i.e.*, without the intervention of such dilatation.

In numerous other cases purely local troubles so undermine the vessel's strength that it ruptures. The writer has shown this for foci of softening; these erode and weaken the wall of some vessel in the involved area; then, of course, rupture easily results. Embolism also, and in like manner, sometimes occasions an early break at the point of plugging. Then tumors not rarely so weaken and drag on the local vessels that small and large hæmorrhages result.

There is no conclusive evidence that either increased blood-pressure or nervous influences are ever of themselves sufficient to rupture a brain-artery, without pre-existing degenerative changes in the vessel-wall.

Though any part of the brain may be the site, there are certain favorite starting-points. These correspond to the territory of the terminal arteries, viz.: the pre- and post- perforating and the branches from the basilar entering the pons. Statistics regarding site have been collected in this country by Dana.

Seventy-seven personal cases apparently confirming Dana's views. Longest duration since attack had been twenty-two years. E. D. Fisher (N. Y. Med. Jour., Jan. 5, '95).

Four cases of traumatic cerebral hæmorrhage, in all of which the vessel ruptured was the middle meningeal. In one case, a man aged 75, operation resulted in perfect recovery. Rasing (Hospitalstidende, No. 3, '93); Littlewood (London Lancet, Feb. 17, '94).

2. As to the blood thrown out. There is less resistance to the outflow in the gray than in the white matter. It may vary in quantity from minute capillary extravasations up to those of several ounces. Some coagulation soon takes place in the extravasated blood; but before this has occurred the blood—if, *e.g.*, it has found a way into the cavities or meninges—may have scattered widely in these spaces and have even passed over

in part to the other side. Where, however, it has not broken through, but been retained in one focus, it remains long enough and sufficiently fluid to work its way into all accessible interstices. This is assisted, so long as the flow continues, by the pressure of the blood in the ruptured vessel. As a consequence, the focus is always irregular and ragged in shape. Much also depends on the surrounding structures; if these are stratified tracts the blood naturally makes a long pocket; if, however, these are soft tissues or matted fibres, then a more globular focus results.

The free fluid and granular material is gradually absorbed, leaving the characteristic brownish pigment and sometimes pultaceous material that long remains like a cyst.

> Experimental studies to determine the age of hæmorrhagic extravasations. Hæmorrhage artificially induced in rabbits through a trephine-opening. Animals lived from one to seventy-two days. Certain changes in cellular metamorphosis and in chemical character found to occur with marked constancy. Most marked changes corresponded with the first, second, fifth, sixth, eighteenth, twentieth, and forty-fifth days. Hæmosiderin is the chemical medium through which the age of the hæmorrhagic extravasation may be approximated. Herman Durck (Review of Insanity and Nerv. Dis., June, 94).

3. Changes of nerve-tissue, caused or provoked by the hæmorrhage. The primary effects consist of tearing and compression of the surrounding substance. The fibres and gray matter may be forced apart, but often they are ground up, disintegrated, and mixed with the blood, making a pulp into which project abundant fragments of severed tracts. Where fibres are simply forced apart, there may be scarcely any of this chowdering, the compression of adjacent tissues being then all the greater. In limited effusions the compression is exerted chiefly on the immediate neighborhood; but, where the volume is considerable, it may affect the whole brain, as is shown by the vomiting, coma, etc.

Nerve-fibres once severed do not, so far as we know, ever reunite; consequently loss of function due to this cause must be permanent. On the other hand, fibres whose function is disturbed by compression or œdema *may* yet regain their usefulness, and to this is due the degree of recovery that we often see. For on this acute stage there follows one of reaction. It is largely due to the accompanying infiltration and inflammatory œdema of adjacent parts that so many cases end fatally in from two to ten days. Even where life is retained this reaction still further jeopards neighboring structures and diminishes the extent of eventful recovery.

There are finally certain secondary changes of nerve-tissue that may develop. These affect only such nerve-fibres as have either been directly severed by the effusion or so much involved as to be unable to recover even their trophic function. Then the portions of these neurons that have been cut off from their respective cells undergo degeneration the same as do severed fibres in peripheral nerves. In the case of the pyramidal or spinal motor tracts this degeneration may extend down the cord to the anterior horns; but the terminal, or spinal, motor neurons, being independent structures, are not generally involved in this process. Of course, fibres going to other parts of the brain will degenerate in like manner if severed from their parent-cells. While in the peripheral nervous system there may be a regeneration of severed or degen-

erated fibres, nothing of the kind is known to occur in the central nervous system.

Prognosis.—This must be based on the following factors and on the accuracy with which we can determine them. There are, however, two separate questions in the matter of prognosis: one has regard to the continuation of life and the other to the extent of recovery from the attack.

The age of the patient. In childhood the rare cases that do occur are usually severe; but, if the attack itself is outlived, the natural recuperative power is so great that the person will live on indefinitely. Improvement may be expected for some years, but entire recovery is unusual.

In middle life the outcome depends on the causal trouble and the severity of the apoplectic attack. Where the motor involvement is not great or is due to indirect pressure, practically complete restitution of all functions is occasionally observed. More often some impairment of the involved area remains. If the primary cause still obtains, this also interferes with recovery and the general outlook.

In senile conditions (tortuous or calcified arteries, dry and wrinkled skin, arcus senilis, etc.) but limited recovery is to be expected. Life may be prolonged, but most depends on the promptness with which the attack is checked. The subsequent length of life depends much on the kindness and care with which the chronic invalid is surrounded.

Nephritis. Here we must distinguish between unimportant secondary or casual albuminuria and real kidney disease. The latter, when present, limits recovery and determines the eventual duration of life. Even with this complication, however, if the site and extent of the effusion be favorable, the paralytic condition may be fully recovered from.

Syphilis. The existence of this systemic infection is principally of etiological importance. It may constitute an indication for treatment, but otherwise has little significance.

Severity and nature of the attack. This is the great guide to prognosis.

Coma, stertor, vomiting, prolonged semiconsciousness, extensive and complete paralysis, etc., indicate a large effusion with much damage to the brain, both in local destruction and general shock. Consequently there is immediate danger to life and much less chance of functional recovery when life is prolonged. In proportion as these features are less prominent the chances for preservation of life and for recovery are increased.

Prolonged high temperature, or a rise to 104° or 106° F., makes a fatal prognosis probable.

General convulsions, as indicative of ventricular rupture (barring uræmia), are a particularly-bad omen, death usually resulting in from a few hours to a few days.

Location and size of the lesion. These two features are complementary. For, though much depends on the site, still a large outpour by its mere volume may include temporarily all the effects of the smaller, and certain general effects in addition.

Pontile hæmorrhages are more often promptly fatal, doubtless from the importance of the local centres and passing tracts. The outpour is also more rapid because from relatively large vessels and close to the parent-trunk. On the contrary, hæmorrhages of the pallium (that part of the cerebral hemisphere above the central ganglia) commonly become

vast in size before inducing as serious symptoms.

Inequality of the pupils developing as a part of the attack, especially where the larger is on the side of the supposed hæmorrhage, suggests a large focus, and hence points to a more serious condition. This is, however, by itself quite indecisive.

After the acute stage has been tided over the extent of presumable recovery is the main matter for prognosis. Here, besides the points already presented, other manifestations have to be considered. The state of the tendon-reflexes in the involved area must be determined; if there is any increase compared with the other side, we can pretty safely conclude that some permanent injury of nerve-tracts will remain, though a slight local increase is not incompatible with apparent functional recovery. Any marked increase of these reflexes—as ankle-clonus or wrist-clonus or a knee-jerk of ten inches, say—means lasting paralysis. The occurrence of œdema or contractures in the paralyzed part signifies so grave a lesion of the motor path as to preclude hope of recovery.

The anæsthesias that are so frequently present in the early or acute stage rarely prove lasting. The occasional development of chorea in the affected extremities is in so far a good sign as it indicates returning conductivity of the motor tracts.

> Three important prognostic indications: 1. Renal disease the most important. 2. Cheyne-Stokes respiration. 3. Hyperpyrexia. If one, two, or all three be present, patient will, in all probability, not recover. Diabetes, chronic alcoholism, typhoid fever, idiopathic anæmia will also exert fatal influence. A. G. Barrs (Brit. Med. Jour., May 18, '95).

Treatment.—It cannot be too strongly urged that the first *desideratum* is a correct diagnosis. Upon this must our treatment primarily depend to be efficacious, since the affections that most closely simulate cerebral hæmorrhage demand directly opposite treatment.

As the therapeutic indications in cerebral hæmorrhage vary considerably according to the stage of the trouble, they can best be considered under four heads:—

Prevention.—In general the prophylactic management is indicated by the etiological factors. If there are any suspicions of prodromata, the patient must be warned against all lifting and straining, the bowels be kept free (calomel or salines), any overtension of the pulse be eased by mild depressants, and the patient kept in a warm atmosphere well protected from all chilling. Digitalis and cardiac stimulants of every sort should be carefully avoided. Any nervous overtension can advantageously be remedied with bromides, and their use here is regularly in order.

> More might be done in the prodromal stage if this condition were more carefully studied. In a large proportion of cases witnessed there were headache, vertigo, sense of fullness in the head, numbness of one side, etc., for a week before attack. It is important to heed these warnings where there is atheroma or high arterial tension without atheroma. Rest, vascular sedatives, nitroglycerin, and large enemata are recommended. Ice-cap of use in allaying restlessness. Aconite to control a too-forcible heart's action. When an attack has taken place, as soon as patient can swallow, mixture of bromide and iodide of potassium, 30 to 40 grains of former, 10 grains of latter, kept up for several days, then bromide omitted and iodide used alone in increasing doses. Preston (N. Y. Med. Record, Feb. 2, '95).

During the Attack.—Some cases are promptly fatal, meningeal and ventric-

ular forms being usually of this kind. Nearly always, however, the effusion progresses for some time. It is here that the physician can be of great service, and as there is rarely time to call for consultants it is important that every practitioner understand the methods fully.

The first and main object is to stop further hæmorrhage. *Our efforts should be directed to a lowering of the arterial pressure, and to a derivation of the blood-current to other parts; i.e., in general to a reduction of the supply to the brain.* For this purpose a variety of means are available and when promptly applied are successful.

Position of the Patient.—The main essential is a sufficiently prone attitude to insure complete relaxation of all the muscles, since we know that muscular effort tends to increase arterial tension. On the other hand, dropping the head too low favors the flow of the blood to the brain: a principle that we apply in cases of fainting, anæmic exhaustion, chloroform syncope, etc. The best position, then, for a patient with progressing cerebral hæmorrhage, is to have the body sufficiently reclining to be fully relaxed and the head considerably elevated.

> Necessity for a change in the accepted teachings. Several instances in which the usual custom of placing the patient suffering from cerebral hæmorrhage in the recumbent posture had been followed immediately by an increase in the gravity.
>
> Rational treatment: patient to be placed in the sitting-erect position and maintained in this position as long as possible; ice to the head and hot water to the feet; energetic purgative, and, in appropriate cases, leeches at any convenient point about the cerebral vessels. Heidenhain (Berliner klin. Woch., Feb. 10, '90).

Sometimes the vomiting in such a case appears to be eased by turning the person on the right side; it is further claimed that turning the person on the paralyzed side eases the stertor.

Vaso-drugs.—The proper use of these remedies is our most valuable single resource. Ergot can well be discarded. The cardiovascular depressants—gelsemium, veratrium, or aconite—are sufficiently powerful and yet ordinarily safe means. Either of these can be administered hypodermically, though they also act promptly by the mouth. Where the pulse warrants its use, it is well to begin with gelsemium. In adults the fluid extract can be started with an initial dose of 2 to 5 drops and followed by drop-doses at intervals dependent on the closeness with which the case can be watched. It should be pushed until its physiological action is manifest, whether little or much is required. The full benefit of the drug is not obtained unless its paralyzing effect is secured.

When medication on this line has to be continued for any length of time, it may be necessary to change, especially from full doses of gelsemium. Then the others become useful. Veratrium is next in order; and both because of the more general familiarity of the profession with this drug, and of our knowledge of its safety from the ample experience with its use in puerperal eclampsia, it will, with most practitioners, prove the most acceptable remedy from the start. With the use of aconite for this purpose I have no experience; but, relying on its physiological action, there is no doubt that in the absence of either of the other drugs this might be a fair substitute. It is usually advisable to keep up some influence of this kind for from a couple of days to a week.

The use of nitroglycerin in this stage

of brain hæmorrhage almost certainly does harm, and should be abandoned.

All stimulants, vascular tonics, morphine, or opiates, and, for the time, strychnine should be carefully avoided.

The possibility of increasing the coagulability of the blood by internal agencies does not yet seem to have been realized.

Autodepletion. — This can be practiced by constriction of the extremities near the trunk. This is a very promptly-acting, but temporary, expedient with many limitations. A coarse binder should be used. Brittle vessel-walls are a distinct contra-indication. Only sufficient force should be used to more or less shut off the veins without affecting the arteries (if too much we but strangle the extremity; if too little we fail of our purpose). Care must be had lest the extremity become too cold. And finally the constriction must be eased up very gradually, lest the sudden influx into the general circulation again start up hæmorrhage.

Warm bottles to the extremities, mustard to the soles, and gentle frictions are, of themselves, useful in drawing blood to the parts, and are doubly so when constriction is resorted to.

Compression of the carotids is a doubtful measure, as the vessels in older patients are easily injured and a steady control of the current for any length of time is rarely possible. Ligature of a carotid is literally adding injury to insult.

> Radical measures should be tried in suitable cases,—cerebral hæmorrhage into right hemisphere, for instance. Direct operation better than ligation of carotid. Angel Money (Intercol. Quarterly Jour. of Med. and Surg., May, '95).
>
> Case of ingravescent cerebral hæmorrhage in which ligation of common carotid stayed the progress of paralysis. Marked improvement followed. Dercum, Keen (Jour. Mental and Nervous Dis., Sept., '94).

Ice to the head is a popular plan, but also of very uncertain value. If used at all for this purpose, it might far better be applied over the carotids in the neck.

Depletion of Body-fluids. — Formerly this was the main treatment, and practiced in the form of venesection. Many still think highly of this procedure for vigorous patients with a tense pulse. "The indications for venesection are a regular, strongly-acting heart, and an incompressible pulse."

Literature of '96 and '97.

> Bleeding is useful and especially indicated in those cases in which the face, head, and neck are turgid, the pulse is hard, full, and slow, and the left ventricle is hypertrophied. It is contra-indicated, however, in cases in which the pulse is feeble, rapid, or irregular, the heart dilated or weak, and the patient very old or debilitated. Byrom Bramwell (Treatment, July 8, '97).

The most common and still accepted method is by purgatives, as a drop of croton-oil on the tongue, a good dose of calomel, or a glycerin-and-sulphate-of-soda enema.

Pilocarpine might be admirable, since it acts both as a depressant and a fluid-depleter, but for certain risks, as of pulmonary œdema.

There may be other matters that require attention. Convulsions should be promptly stopped, and for this purpose a few whiffs of chloroform may suffice. The efforts of vomiting are injurious, but it is seldom possible to arrest them.

If the bladder is full, catheterization may be necessary.

Treatment of the Reaction (or the Subacute Stage).—Here there is still some shock, an actual destruction of brain-tissue, a compression of adjacent tracts by the extravasation, and an inflamma-

tory reaction of immediately-surrounding parts. We have little to offset this. Counter-irritation can hardly act that deeply. Iodides, to favor quick absorption of clot, are the routine treatment.

Trephining, with evulsion of clots, would be in order in this condition, although, owing to difficulty in exact localization and the usual depth of the focus below the surface, such operative relief is rarely feasible. During this period we may have to continue depressants, and wait with nux vomica or its alkaloids. "Negatively the use of digitalis in a patient who has once suffered from brain-hæmorrhage is ever after a risky matter."

Case of trephining for a basal lesion, the condition being diagnosed from the beginning as an apoplexy at the base. The success attending it will doubtless encourage the performance of that operation in similar cases, and widen the basis whereby it is rendered justifiable. Smart (Brit. Med. Jour., Dec. 5, '91).

Case of a man who fell; twenty minutes afterward he became unconscious and had a convulsion. These indicating compression over the right motor tract, trephining was done on that side. As soon as the skull was perforated, there was a profuse and persistent flow of blood, amounting to between 4 and 6 ounces from the middle meningeal artery. The man resumed work about six weeks after the accident. Stewart (Edinburgh Med. Jour., Feb., '92).

Case in which the breathing, characterized before operation by lengthened intermissions, and well-nigh suspended, had become almost normal before the operation was completed, and thereafter continued to improve. This effect was especially noticeable after incising the dura, which was immediately followed by cerebral hernia, thereby giving relief to the cerebral pressure and tension. Smart (Brit. Med. Jour., Dec. 5, '91).

Delirium, and restlessness two weeks and absence of mental functions six weeks after operation, followed by recovery, with only slight hesitation in speech. Porter (Boston Med. and Surg. Jour., July 4, '95).

Persistence of paralysis forty days after operation for traumatic middle meningeal hæmorrhage, followed by rapid and complete recovery. Alexis Thomson (Edinburgh Med. Jour., Jan., '95).

Literature of '96 and '97.

Case of traumatic hæmorrhage into the white brain-substance followed by aphasia, hemiparesis, and Jacksonian epilepsy. Recovery after surgical interference.

Conclusions: 1. Extravasations of blood of traumatic origin can be removed from the brain-substance by surgical methods, as well as contused and destroyed brain-substance, and in the same manner pathological and circumscribed portions of brain-matter. 2. It is possible that extravasations of blood other than those of traumatic origin may be removed by surgical interference. 3. The brain does not resent surgical procedures more than any other part of the body. Borsuk and Wizel (Archiv f. klin. Chir., B. 54, H. 1, '97).

For the hemiplegic after the condition has settled down into the chronic stage our resources are sadly limited. Strychnine or its congeners internally, sometimes electricity locally to the muscles, and care of the general health comprise all that is rational in customary procedure.

Recently a German writer has done good service by calling attention to the importance, in these cases, of doing everything to bring activity again into the patient's impaired nerve-tracts. He shows that by rousing these persons, lifting them—when not too feeble—into a sitting position, getting them once more interested in life; further, by exercising actively and semipassively the paretic muscles, we can save the patient from the further degeneration that so often ensues and may even effect great

gain. To the value of this principle I can heartily subscribe. Ere beginning this plan, however, we must wait until the danger of immediate relapse is past, —say, usually until the end of the first week or ten days.

WILLIAM BROWNING,
Brooklyn.

CEREBRAL MENINGITIS. See MENINGITIS.

CEREBRITIS. See ENCEPHALITIS.

CEREBROSPINAL MENINGITIS. See MENINGITIS.

CERIUM. — This is an exceedingly rare metal, found in nature only in the form of a hydrated silicate. Its chief source is a Swedish mineral known as cerite, though it also occurs in brown apatite, and is always found in connection with lanthanum and didymium. Unfortunately the salts that are employed medicinally are often found disappointing in therapeutic efficacy, owing to the presence of these two latter minerals. Cerium is white, very brittle, almost infusible, and insoluble in water. Its salts appear as white granular powders that for the most part are only slightly soluble in water and alcohol, and one, the oxalate, is wholly insoluble therein; with the exception of the valerianate, all are practically odorless and tasteless.

Preparations and Doses. — Cerium bromide, 5 to 20 grains.

Cerium nitrate, 1 to 10 grains.

Cerium oxalate, 2 to 15 grains.

Cerium valerianate, 1 to 10 grains.

Physiological Action. — Practically nothing is known as to the physiological action of the cerium salts; not even their elimination is understood. They are, however, tonic, sedative, and antacid, and the bromide and valerianate are also to some degree antispasmodic.

Therapeutics.—The bromide salt is a comparatively recent introduction, but it is the least valuable of the bromides, and as a tonic and sedative inferior to other preparations. The nitrate was introduced by Sir James Y. Simpson as substitute for bismuth salts, nitrate of silver, and hydrocyanic acid. "In chronic intestinal eruption, a peculiar and intractable form of disease for which arsenic and silver nitrate are generally prescribed, Simpson employed the salts of cerium with marked advantage" (Waring).

GASTRIC DISORDERS. — In irritable dyspepsia attended with gastrodynia, pyrosis, and chronic vomiting there is no remedy so prompt and satisfactory as cerium oxalate or valerianate; both, too, often afford ready relief in the vomiting of pregnancy; but, as before remarked, it is desirable that the salt be pure.

In seasickness French authorities praise the valerianate; but here it is admittedly greatly inferior to amyl-nitrite given by the mouth.

> Oxalate of cerium tried in seasickness in doses of 10 to 25 grains every two to three hours. It is superior to any other means personally tried. Also found serviceable in hundreds of cases of sick headache and in the morning sickness of pregnancy, but it must be in doses of at least 10 grains to do any good. W. H. Gardner (Med. Record, June 2, '88).
>
> Cerium given in seasickness in doses of ½ ounce every two hours in a number of cases. Opinion expressed that it will relieve more patients than any other remedy yet suggested. M. C. Waldron (Med. Record, June 23, '88).

In diarrhœal conditions, or any form of irritation of the intestinal tract, either the oxalate or valerianate prove

far superior to any of the bismuth salts; so also in any form of vomiting that is reflex from intestinal or cerebral irritation, spasmodic in character.

NERVOUS DISORDERS.—Whooping-cough, too, is sometimes relieved in a most striking way by salts of cerium.

In epilepsy, chorea, and other convulsive diseases in which nitrate of silver is frequently employed, cerium salts deserve trial, for, as Simpson remarks, they are certainly attended with the advantages that, at the same time, they act as tonics and sedatives. Their use may be persevered in without endangering appetite or digestion and without fear of discoloring the skin.

In some cases of migraine the cerium salts afford speedy relief; but it is probable that here the chief value of the remedy lies in its antacid effect.

Literature of '96 and '97.

In the gastric crisis of locomotor ataxy cerium oxalate may be employed with decided success. The duration of the attack is lessened, the vomiting greatly reduced, and the pain and nausea relieved, sleep returns, and alimentation is, to a certain extent, possible. Ostankoff (La Méd. Mod., Aug., '96).

Case of a woman, 40 years old, hysterical, who was accustomed to take oxalate of cerium, and who finally developed a cerium habit. She once took ½ ounce in six hours and during two months ingested 5 ounces. No apparent effect was noticeable, though she declared it made her "feel more comfortable." Craigen (Med. Standard, Sept., '96; Med. Age, Oct. 26, '96).

CERUMEN IN EAR. See EXTERNAL EAR.

CESTODES. See INTESTINAL PARASITES.

CHALAZION. See BLEPHARITIS.

CHAMOMILE.—There are two kinds of chamomile employed in medicine, known respectively as Roman and German: the former a native of southern Europe, the latter of Great Britain and northern and middle Europe.

Roman chamomile is the flower-heads of *Anthemis nobilis*; they are subglobular, about three-fourths of an inch broad, consisting of numerous white, strap-shaped three-toothed florets inserted upon a chaffy, conical, solid receptacle. The odor is agreeable, but the taste bitter and aromatic.

German chamomile, or *false* chamomile, as it is often termed, is the flowers of *Matricaria chamomilla*; these are smaller than those of Roman, or *true*, chamomile, and have a stronger, less agreeable odor and taste. Both yield a volatile oil, which appears to be practically the same. The properties of the two forms appear to be identical; hence the German variety requires no specific mention beyond the fact that it is inferior in strength.

Preparations and Doses.—Chamomile extract (solid), 5 to 12 grains.

Chamomile extract (fluid), 30 to 60 minims.

Chamomile infusion, 2 to 6 drachms.

Chamomile, powdered leaves, 20 to 60 grains.

Chamomile tincture, 2 to 5 drachms.

Oil of chamomile, 1 to 10 minims.

Physiological Action.—Chamomile is an aromatic, tonic febrifuge, and in large doses emetic and antispasmodic. The oil is stimulant and antispasmodic, and has a powerful lowering action on the reflex irritability of the spinal cord.

Therapeutics.—Chamomile has been employed in flatulence, colic, intermittents, dyspepsia, debility, etc.; but it has been very much neglected of late years, doubtless because the fluid extract

and tincture do not yield the same therapeutic effect as the warm infusion, and the latter is considered unpalatable and bulky. It is, however, deserving of greater employment and more thorough study. An infusion of the flowers made fresh and taken warm is an excellent diaphoretic.

Scabies.—In France, equal parts of fresh chamomile-leaves, olive-oil, and lard constitute a popular remedy for scabies. It is said to effect a cure by three frictions, to instantly sooth all irritation, and not to give rise to any secondary affections. (Bazin).

CHANCRE. See Syphilis.

CHANCROID. See Syphilis.

CHAPPED LIPS. See Lips.

CHARCOT'S DISEASE. See Joints, Diseases of.

CHAULMUGRA-OIL.—This is a pale-brown or yellowish-brown oil obtained by expression from the seeds of the *Gynocardia odorata*, which is a native of farther India, more particularly of the Malay Peninsula, and is most abundant in the forests between Sikkim and Rangoon. It is always solid and unctuous in the temperate zone; has a disagreeable taste and smell; and is a compound of palmitic, hypogæic, cocinic, and gynocardic acids, of which latter a fair product will usually yield from 10 to 12 per cent. The oil generally found in market is rarely pure; and doubtless its variable characteristics are responsible for the fact it no longer enjoys in Europe and America the reputation that obtains thereto in India and the Orient.

Gynocardic acid is the active constituent. It is a yellow, unctuous solid with acrid, burning taste, the odor of the oil, and melts at 85° F. With sulphuric acid it strikes a green color, which has been cited as a test for character and purity; but, unfortunately, palmitic acid gives the same precise reaction.

Preparations and Doses.—Chaulmugra liniment.

Chaulmugra-oil, 5 to 30 minims.

Chaulmugra ointment (1 to 3).

Gynocardic acid, 1 to 5 grains.

Physiological Action. — Chaulmugra-oil (or chaulmoogra-oil) and gynocardic acid alike appear to be highly alterative and tonic in action. Both, in medium doses, leave an unpleasant taste in the mouth, and likewise some irritation of throat and pharynx; later a feeling of nausea supervenes, with oppression in the epigastrium, followed, perhaps, by vomiting, usually by slight purging, after which all symptoms quickly subside. The gynocardic acid is less likely to produce nausea; hence is more readily tolerated. Under continued administration nutrition seems to be improved, and a gain in weight is likely to be observed.

Applied locally, both are demulcent and lubricant; but, like all fatty substances, they act more benignly when the acute stages of inflammation have passed. This fact should always be borne in mind when prescribing as an ointment or liniment or when applying pure in skin affections, to inflamed joints, etc.

Therapeutics. — The inhabitants of southeastern Asia have long employed chaulmugra-oil, both externally and internally, in the management of leprosy, skin diseases of a chronic scaly variety, in scrofula, rheumatism, etc. Its most prominent effects have been observed in the tubercular and anæsthetic forms of leprosy; in psoriasis, lupus, and allied skin affections; in old eczemas with

thickening of the skin; in scabies and ringworm; in the form of liniment as an application in rheumatic arthritis, rheumatic gout, stiff joints, and strains. Mixed with chloroform and menthol it appears to have been very beneficial in some cases of neuralgia, sciatica, etc.

In giving the oil internally it is best to begin with 3 or 4 grains, administering after meals, and gradually increasing to the limits of toleration, which will usually be found somewhere between 30 and 60 grains. If the acid is employed, it is best administered in the same way, viz.: $^1/_2$ grain after meals and gradually increased to 3 or 5 grains. It must be admitted, however, that these preparations do not seem as active in the temperate zone as in the tropics, and that the white races are not so appreciably affected thereby as the dark.

CHEST, INJURIES OF. See THORAX, WOUNDS AND INJURIES OF.

CHICKEN-POX. See VARICELLA.

CHILBLAIN. See PERNIO.

CHILLS AND FEVER. See MALARIAL FEVERS.

CHLORAL: ITS DERIVATIVES AND COMPOUNDS.—Chloral, or anhydrous chloral, is by no means chloral-hydrate, as is generally imagined and so very erroneously taught. Chloral, *per se*, is a trichloracetic aldehyde, and can be obtained only in the form of a colorless liquid, which, when shaken with water, absorbs one molecule of the latter and forms a solid, constituting chloral-hydrate. It also possesses an aldehyde odor; it boils at 201.2° F., while chloral-hydrate only boils at 207° F. By oxidation it forms trichloracetic acid, and the action of nascent hydrogen reduces it to aldehyde; by the alkalies it is at once decomposed into chloroform and a formate of the alkali employed. True chloral is difficult to keep, and always requires to be tightly corked in a dark-hued container and carefully set away in a dark, cool place. It possesses little interest for the physician, except as being a source of chloral-hydrate, and the fact that sulphuric acid added to the latter causes it to decompose into meta-chloral and chloral.

Preparations and Doses.—Chloralamid (chloralamide; chloral-formamide), 10 to 45 grains.

Chloral-ammonium, 15 to 30 grains.

Chloral-antipyrine (hypnal), 15 to 30 grains.

Chloral, butyl- (see BUTYL-CHLORAL, *post*).

Chloral-caffeine, 3 to 10 grains.

Chloral-carbamide (see CHLORAL-URETHANE).

Chloral-camphor (camphorated chloral), topical chiefly; internally, 10 to 20 minims.

Chloral-carbolate (chloral-phenol; phenyl-chloral), topical only.

Chloral, croton- (see BUTYL-CHLORAL).

Chloral-formamide (see CHLORAL-AMID).

Chloral-cyanide (see CHLORAL-HYDROCYANATE, *post*).

Chloral-glycerate, as a solvent only.

Chloral-hydrate, 10 to 50 grains.

Chloral-hydrocyanate, $^1/_4$ to $^1/_2$ grain; equals 2 to 4 minims of B. P. acid.

Chloral-imide (chloralamid; trichlorethylidenimide), 10 to 30 grains.

Chloral-menthol (menthol-chloral; mentholated chloral), for topical use.

Chloral-ose, or chloralose, 1 to 3 grains.

Chloral-quinine, 3 to 10 minims.

Chloral-thymol, topical application only.

Chloral-urethane (ural; uraline; uralium; urethane-chloral), 10 to 45 grains.

Chloral suppository, 15 grains of mixture.

Chloral syrup, 30 to 120 minims.

Chlorobrom, or chloro-brom: a mixture of potassium bromide and chloral-amid.

Bromochloral, compound liquid of, 30 to 120 minims.

Butyl-chloral (croton-chloral), not in use.

Butyl-chloral-hydrate, 15 to 30 grains.

Butyl-chloral-antipyrine (butyl-hypnal), 15 to 30 grains; little used.

Butyl-chloral mixture, 4 to 8 drachms.

Butyl-chloral pills, 1 every one or two hours.

Butyl-chloral pills with gelsemium, 1 every one or two hours.

Butyl-chloral syrup, 1 to 4 drachms.

Somnal (proprietary), 10 to 30 grains.

Glycerole of chloral and camphor, external only.

Chloral-ammonium is a white, crystalline powder with a chloral odor and taste, soluble in alcohol and ether, insoluble in cold and decomposed by hot water, melting at about 147° F. It is employed as an hypnotic and analgesic, is claimed never to disturb the stomach, and to be devoid of all the unpleasant factors peculiar to chloral-hydrate: claims by no means substantiated. It is employed chiefly in nervous insomnia of all kinds and also in mental troubles.

Chloral-antipyrine is, perhaps, better known by its trade name: "hypnal." It is scarcely so much a chemical as a mechanical compound, and is had in colorless crystals that are soluble in six parts of water. It is hypnotic, analgesic, antipyretic, and antiseptic, and chiefly employed in insomnia, headache, spasm, cough, etc.

Chloral-hydrate is the drug in most frequent use, and, as already remarked, is obtained by the addition of one molecule of water to anhydrous chloral, whereby are formed crystals (monoclinic prisms) melting at 135° F., and at 207.5° separating into chloral and water; the vapor is not combustible. It has a somewhat pleasant, penetrating, pungent, aromatic odor, in which, also, is speedily recognized more than a mere suggestion of acridity. Bitter to taste, it is also, in some degree, caustic; is more or less volatile according to the atmospheric conditions to which it is exposed; soluble in almost anything and everything, including fixed and volatile oils; and, when triturated with equal proportions of stereopteus or camphoraceous bodies, combines to produce a liquid. A great deal of the chloral-hydrate marketed is of impure quality, being in combination with chloral-alcoholate (to the presence of which untoward accidents are frequently laid), hydrochloric acid, chlorides, etc. The test authorized by the British Pharmacopœia is that of sulphuric acid acting on a strong solution of the drug in chloroform, whereby, if absolutely pure, no brown color is developed; the U. S. P. directs the acid to be employed without chloroform and the mixture also to be warmed, and requires it shall not blacken. Manifestly the last test is not as reliable or delicate as that of the B. P. A fair idea of purity can be had, however, by pressing between two leaves of blotting-paper, when, if impure, oily spots will be formed. It should make a neutral solution with water without forming oily drops; should not be decomposed readily by the action of the atmosphere; the aqueous solution acidulated with nitric acid affords no evidence of chlorine when treated with silver nitrate.

Chloral-caffeine appears as colorless,

glittering, small rods or leaflets, soluble in water. It is said to be a molecular combination of the drugs represented, but this has never been definitely proved; certain it is that alkalies decompose it into chloroform and caffeine. Being hypnotic, sedative, and analgesic, it has been employed, both by the mouth and hypodermically, and in nervous insomnia, neuralgia, sciatica, rheumatism, headache, etc.

Chloral-camphor or camphorated chloral, *thymolated chloral, carbolated chloral, quinine-chloral,* and *mentholated chloral,* with the exception of the first named, are employed only in a topical way; all are made by melting the respective constituents with chloral. Thus the camphorated—which appears as a transparent, almost colorless, syrupy liquid—is prepared by triturating equal parts of gum camphor and chloral-hydrate in a warm mortar; it is soluble in all proportions in alcohol, ether, oils, and fats, but not at all in pure water; is antiseptic, analgesic, and slightly epispastic applied externally, and internally administered powerfully hypnotic and narcotic.

Chloral-phenol is an oily liquid composed of 3 parts of carbolic acid and 1 part of chloral-hydrate; is analgesic and antiseptic, and employed by inhalation, or is topically applied.

Chloral-quinine is another fluid developed by mechanical mixture of two drugs, but is more of a curiosity than a medicament.

Chloral-menthol and *chloral-thymol* differ little from chloral-camphor, and are put to much the same uses.

Chloral-formamide, or chloralamid, is unfortunate in having a rival called chloralimide or chloral-imide, the latter being a trichlorethylidenimide. Therapeutically, they are practically identical, save that the latter is about one-third more active and is not decomposed by water. Both are obtained as bitter, lustrous, colorless crystals, decomposed by heat, soluble in alcohol, 1 to 2, and in water about 1 to 20. They are hypnotic, but not analgesic. The claim is advanced that undesirable effects are less frequent and less marked than from chloral-hydrate, but this is probably true only as regards the measure of activity. Neither are, in any degree, uniform as to action.

Chloralose is obtained from anhydrous chloral and glucose by means of heat, whereby are formed small, colorless crystals of bitter, disagreeable taste, slowly soluble in water, readily so in alcohol. It is deemed an hypnotic, and claimed to act by reducing the excitability of the gray matter of the brain, and also that it is free from the disagreeable after-effects manifested by the heart, and the cumulative tendency that sometimes follow the exhibition of chloral-hydrate. Properly this compound is an anhydroglucochloral, and in large doses is intensely toxic.

Chloral-urethane (known also as chloral-carbamide, urethane-chloral, ural, uralium, and uraline) is obtained by heating chloral-hydrate with urethane, then successively adding concentrated hydrochloric and sulphuric acids. It appears both as colorless, shining, laminated crystals and as a white powder, soluble in alcohol and ether. It is recommended as an hypnotic, especially in epileptic dementia, but is uncertain in effects and disagreeable to take, and not infrequently nausea and disorders of digestion follow its exhibition.

Chloral-hydrocyanate comes in white rhombic prisms, or as a white crystal powder, soluble in alcohol, ether, and water. It contains 15.33 per cent. of

hydrocyanic acid, and is superior to the latter in that it is more permanent, and the dose more exact. One part dissolved in one hundred and sixty-six parts of water makes bitter-almond water.

The "*liquor bromo-chloral compositus*" of the British Pharmacopœia is made by dissolving 1600 grains of chloral-hydrate in 400 minims each of tincture of cannabis Indica, and tincture of fresh orange-peel, 1600 minims of henbane-juice, 30 drachms of syrup, and 4 drachms of fluid extract of licorice; then is added 1600 grains of bromide of potassium, previously dissolved in 7 ounces of distilled water, and the whole filtered; finally sufficient distilled water is added to bring the amount up to 20 imperial ounces.

Chloral suppositories, each containing 5 grains of chloral-hydrate and 10 grains of cacao-butter (oleum theobromæ), cannot be made with heat, for even if it should not wholly decompose the chloral, the mixture will not set firm; instead, the combination, which, by the way, is apt to be very irritating, must be obtained by compression in molds. The suppositories are very useful in infantile convulsions where nothing can be administered by the mouth, and each one should be forcibly retained within the sphincter for a few moments, by the finger if necessary.

Syrup of chloral is obtained by dissolving 80 grains of chloral-hydrate in 90 minims of water, and then adding simple syrup enough to make 1 ounce.

Butyl-chloral-hydrate—or croton-chloral-hydrate as it is sometimes, but wrongfully, termed—appears in pearly-white crystalline scales possessed of a pungent odor resembling that of chloral-hydrate, and an acrid nauseous taste; it is soluble, 1 to 43, in cold water, freely soluble in rectified spirit, and 4 to 1 of glycerin. It is available in the same way as chloral-hydrate, and is claimed to be more efficacious as an analgesic, especially in neuralgias.

Butyl-chloral-antipyrine or butyl-hypnal, appears as colorless, transparent needles of butyl-chloral odor and bitter taste, which are soluble in alcohol, ether, chloroform, benzin, and (1 to 30) water. Perchloride of iron gives a red solution; alkalies decompose into antipyrine, alkaline formate, and propyl-chloroform. Its properties resemble those of hypnal. Butyl-chloral mixture, which is a very useful anodyne, is made by dissolving 4 grains of butyl-chloral in 15 minims of glycerin and water to make 1 ounce.

Butyl-chloral pills are made of a strength of 3 grains each of the drug added to sufficient glycerin of tragacanth or mucilage of gum arabic to make a mass; when the same are desired with gelsemium, hydrochlorate of gelsemine, in the proportions of $^1/_{200}$ of a grain, is added to each pill.

Butyl-chloral syrup is merely 16 grains of the drug dissolved in 1 ounce of hot syrup.

Glycerite of chloral is merely 1 part of chloral-hydrate in 4 parts of glycerin, and is employed chiefly as a solvent for certain alkaloids.

Glycerole of camphor and chloral, which is a very effective anodyne embrocation, is made as follows:—

℞ Camphor, powdered, 75 grains.
Chloral-hydrate, 60 grains.
Glycerin, 4 drachms.
Alcohol, 3 drachms.
Juniper-oil, 30 minims.

Mix in a glass container and expose to gentle heat (not over 104° F.) until solution is effected. Let cool, bottle, and keep well stoppered.

Carmine-chloral—which is so useful to

microscopists as a stain, and invaluable in examining pollen nuclei—is made as follows: Carmine, 2; absolute alcohol, 20; hydrochloric acid, 2 parts; heated on a water-bath for thirty minutes; then, adding 25 parts of chloral-hydrate, cool and filter.

Hypodermic Use.—Chloral-hydrate has been administered hypodermically, but is generally to be condemned on account of its caustic action, the necessity of multiplying punctures, and of employing very dilute solutions. Vulpian declares that it tends to induce hæmaturia, though not to the same degree as when employed by intravenous injection. Croton-chloral is a trifle more suitable from a remedial stand-point, but not from a physical one; it is also highly irritant. Leoni recommends the following solution; 16 minims of which contain $^3/_4$ grain of the drug: Croton-chloral, 16 grains; warm glycerin and cherry-laurel water, of each, equal parts up to 352 minims.

Physiological Action.—Externally applied, all chloral preparations are more or less irritant, but likewise antiseptic and sometimes analgesic.

Internally they are generally sedative to the nervous system, and secondarily to the heart: a feeling of lassitude, of irresistible drowsiness, or even sleep may be produced (though sometimes preceded by a stage of excitement, particularly in alcoholics), slowing of pulse and respiration, and pupillary contraction. Sensibility and reflex excitability are not disturbed by ordinary medicinal doses, but disappear when large amounts of the drug are exhibited. There is also lowering of temperature. Probably brain-anæmia is induced, whereby sleep follows, the act being more nearly normal, physiologically, than that produced by any other drug, there being no *malaise* on awakening.

Liebreich, who first introduced chloral, believed that it exerted its effect through the circulation by liberating therein free chloroform and formic acid; but this seems improbable, because the alkali of the blood is too feeble to effect the transformation, and its albumin is considered antagonistic to such a process. Again, no smell of chloroform can be observed in the breath, and no anæsthetic effect is produced on the sleeper by moderate doses. Farquharson ("Therap. and Mat. Med.," '89).

Chloral-hydrate induces sleep identical in every respect with sound, natural, refreshing slumber, lasting 5, 6, or 8 hours, devoid of dreams and free from stupor or narcotism, and not followed by gastric or other troubles. It does *not* act by being decomposed in the blood into chloroform on meeting the alkali of the circulating fluid.

It causes reduction of temperature, and Brunton found that this was so great as to alone cause death. The motor nerves or muscles are not directly affected, but the pupil is contracted. The drug appears in the urine, and if this secretion be alkaline it may change chloral into chloroform. Whitla ("Pharm., Mat. Med., and Therap.," '92).

Literature of '96 and '97.

Chloral has antiseptic properties, destroying low organisms and preventing the decomposition they induce. Small doses are without obvious effect upon the stomach; large doses may be followed by nausea and vomiting. Biddle ("Mat. Med. and Therap.," '96).

Chloral-hydrate acts upon the cerebrum as a powerful and certain hypnotic; acts as a depressant to the centres at the base of the brain; depresses the functions of the spinal cord; produces slowness and weakness of the heart's action, vasomotor paralysis, and muscular weakness with anæsthesia. Murrell, Lond. ("Man. of Mat. Med. and Therap.," '96).

Butyl-chloral-hydrate acts very much

like chloral-hydrate, but is less powerful as an hypnotic, induces somewhat less cardiac depression, is not so irritating to mucous membranes, and appears to have a specific action upon the branches of the fifth pair of nerves. Liebreich believes that its action upon the heart in even fairly large doses is not dangerous, and that life can be saved by means of artificial respiration after the respiration-muscles have ceased action, but the erroneousness of these conclusions has been demonstrated in the physiological laboratory. It is evident that its administration cannot be conducted with much less caution than that of chloral-hydrate. It is largely eliminated by the kidneys as urobutylchloralic acid.

Literature of '96 and '97.

The action of butyl-chloral-hydrate is quite similar to that of chloral-hydrate, though it is considered less depressing to the heart and circulation, while possessing anodyne properties, having a selective action upon the fifth nerve; it often produces anæsthesia of the trigeminal nerve before any other action is made manifest. But as a simple hypnotic it is feebler and more uncertain than chloral-hydrate. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Butyl-chloral-hydrate has hypnotic powers, but it is so rarely used for this purpose that on practical grounds it should be dissociated from the group of hypnotics in spite of many structural and other affinities. It produces anæsthesia of the head without loss of sensibility to the rest of the body, which in man is confined to the area of the fifth nerve. In large doses it produces sleep, and in fatal doses destroys by paralyzing the medulla oblongata. Ringer and Sainsbury ("Manual of Therap.," '97).

Chloralamid.—A marked effect of this drug is its tendency to produce mucous diarrhœa. It acts more powerfully upon the cerebral cortex than any other portion of the nervous system, causing sleep and muscular relaxation; is claimed to be only feebly depressant to the cord, and in medicinal doses to have little effect upon the circulation. It was introduced as a substitute for chloral-hydrate, backed by the assertions that it was less unpleasant to take, absolutely without objectionable effect on the heart, and that its hypnotic effect is two-thirds that of chloral. Although it acts with tolerable certainty in simple insomnia, it generally fails, if administered in medicinal doses, when pain and excitement are present. On the whole, it cannot be said to have met the expectations raised in its behalf. In moderate doses it seems to sometimes stimulate respiration, rendering it deeper and fuller, but unless its administration is carefully watched an opposite effect is soon produced.

Literature of '96 and '97.

The physiological action of chloralamid is similar to that of chloral upon the cerebrum, but upon the circulation is ordinarily so slight as to offer a marked contrast to the depression produced by the latter drug; only in large or poisonous doses does it depress the heart and cause a fall in blood-pressure. A moderate degree of respiratory depression may follow the administration of large amounts, and death results from paralysis of respiration. It has been thought to have a soothing effect upon the spinal centres and thus to diminish reflex excitability, but its action upon the nervous system other than the cerebrum is hardly appreciable. It is excreted as urochloralic acid. Griffin (Foster's "Prac. Therap.," '96).

Upon the action of this drug a large amount of experience has been accumulated by a number of observers, the world over, and the general verdict is that it does not depress the heart or circulation, does not lower temperature, that it exerts a decided action in many cases of insomnia from pain, and that after-effects and by-effects are rarely witnessed. At the same time it must be admitted that

collapse symptoms have been observed in a few cases and likewise erythematous eruptions. It certainly is a very valuable hypnotic. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Chloralose.—This drug was introduced as a substitute for chloral-hydrate, with the claim that it is hypnotic,—causing sleep in birds and mammals as well as in man,—analgesic, exerts its effect chiefly upon the gray matter of the brain, and unlike chloral does not depress the spinal cord; also that it is without any irritant effect on either stomach or intestines; indeed, that it is entirely devoid of unpleasant after-effects—all of which has by no means been definitely substantiated. It should be administered with caution.

Administered to one hysterical patient; some symptoms of poisoning were observed; the sleep was profound and the breathing stertorous; involuntary urination during sleep: a symptom never before exhibited. Féré (Compt. rend. Hebd. des Séan. et Mémoires de la Soc. de Biol., Feb. 28, '93).

Chloralose acts especially on the brain and spine. It is a convenient and reliable hypnotic, from which awakening is easy; vomiting, nausea, headache, lowering of arterial pressure, accumulation, or tolerance is not produced. It is a stimulant to the heart through the medulla. Goldenberg (Thèse de Paris, '93).

The introducers assert that 75 grains will, in a dog of 2 1/4 pounds' weight, produce symptoms of intoxication followed by a most profound sleep in which all sensibility is lost, although the reflex activities are greater than normal. Upon the circulation the drug has but little power, the arterial pressure—even when there is profound unconsciousness—being scarcely affected. During unconsciousness not only is the motor side of the spinal cord more active than normal, but the cerebral cortex was also found to be extremely excitable. H. C. Wood ("Princ. and Prac. of Therap.," '94).

The toxic dose is about $^1/_{10000}$ of the body-weight. When injected into a frog in this proportion produces a condition similar to that observed after removal of the cerebral hemispheres. Spontaneous movements are abolished, but reflex and automatic actions remain intact. Soon afterward, however, respiration is paralyzed, followed by the disappearance of all reflex activity, and the animal lies apparently dead; but on opening the thorax the heart is found beating quite vigorously, this cardiac action continuing for two or more hours after the abolition of the respiratory movement. The sleep produced in man is sometimes preceded by muscular tremors or simple twitchings, dizziness, and difficulty of speech; the sleep is more profound than normal, the patient becomes insensible to pinching or pricking of the skin, and the corneal reflexes seem to be absolutely abolished. Chambard (Revue de Médecine, Apr. 10, '94).

The respiration is slowed, and by large doses its rhythm is somewhat altered. Cappelletti (Uniao Méd., Sept., '94).

The drug has a tendency to lower body-temperature. It also diminishes the amount of urine, this phenomenon being accompanied with an increase of specific gravity, and decrease of urea and chlorides. Lombrose and Marro (Giorn. della reale Acad. de med. Torino, June, July, '93).

The action of chloralose is chiefly upon the brain and the spinal cord. On the brain it causes two effects, one of depression and one of excitability, the former intense and lasting, the latter slight and fugacious. The depressant action presents itself as sleep and sedation; the sleep comes rapidly, is exceptionally preceded by intoxication; heaviness of the head, stupor, or moderate cephalalgia, this being often quite marked, but not exaggerated; at other times lassitude, feebleness of the lower extremities, and various other troubles on different days, the narcosis being followed by a feeling of well-being. The drug also has the peculiar property of

causing physical blindness; it is capable of producing dilatation of the pupil and diminution of visual acuteness, sometimes accompanied with diplopia. It increases the appetite markedly, and exceptionally may cause gastric disturbances, eructations, thirst, and vomiting. It does not produce an increase in the amount of urine secreted, but causes a relative polyuria immediately after its administration. (Montyel.)

Toxic symptoms observed in two patients: one suffering from diabetes, the other from uterine fibroid, the symptoms being trembling, starting, nausea, vomiting, a species of dull restlessness accompanied by incoherence, and involuntary evacuation of urine and fæces. Touvenaint (Le Prog. Méd., No. 19, '94).

Three grains of the drug produced poisonous symptoms in a child of 6 years: there was trembling, convulsions, and later a cataleptiform condition which lasted two hours. Bardet (Le Bull. Méd., Feb. 18, '94).

Nocturnal paralysis followed a dose of 3 grains administered to an adult. Féré (Rev. Neurolog., No. 6, '94).

Trembling and intellectual stupor observed in adults. Morel-Lavallée (Le Bull. Méd., Feb. 7, '94); Villeprand (*ibid.*); Talamon (La Méd. Mod., Jan. 27, '94).

Complete loss of memory in one instance after the ingestion of 4 grains; intense prurigo as the result of a like dose in another; symptoms of paresis with threatened asphyxia in a third. Lombroso (Riforma Med., No. 131, '93).

The ingestion of 4 grains of chloralose in two hours induced complete insensibility and coma; the pulse was 180, the heart-beats imperceptible, face and extremities cyanosed, epileptoid movements of limbs, and cold perspiration. Death seemed imminent. Rendu (Le Bull Méd., Mar. 10, '95).

Five or six similar cases were published in La Médecine Moderne during 1894. Several were reported to the Société de Thérapeutique. Russian physicians, notably Chemelewski, added to the category. Herzen (Revue Méd. de la Suisse Rom., June 20, '95); Delabrosse (La Normandie Méd., No. 15, '95); and Dufour (Marseille-méd., Dec. 15, '95) corroborate as the result of personal experiences.

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The drug has one very important defect in that it occasionally provokes toxic symptoms, which manifest themselves by an exaggeration of the reflex excitability of the medulla oblongata, amounting almost to convulsions; in addition to this, it is very difficult to decide upon the proper dose, as its action varies not only in different persons, but even in the same person. Foster ("Prac. Therap.," vol. i, '96).

Chloral-hydrocyanate has the action of the cyanides; it is about one-seventh as strong as prussic acid. It is an excellent preservative of solutions intended for hypodermic use.

Chloral-caffeine has been introduced for the treatment, hypodermically, of sciatica and other rheumatic affections, and all cases of irritation of the peripheral nervous system. It has been employed subcutaneously in doses of from 2 to 5 grains, and is said to be painless. Its physiological action has not, as yet, been definitely worked out.

Chloral-carbamide, or chloral-urethane, is hypnotic, partakes of the action of chloral-hydrate, but is uncertain in effects, disagreeable to take, and is often followed by nausea and disorder of digestion.

Hypnal, or chloral-antipyrine, has all the properties of chloral-hydrate, including all the objectionable features of the latter, and depresses the heart more seriously. It is claimed that the antipyrine renders it analgesic, and therefore will induce sleep in the presence of pain; but such action is uncertain and ephemeral.

Butyl-hypnal apparently differs in no way from the preceding.

Toxic and Untoward Effects.—The toxic and untoward effects, except as has heretofore been stated, are practically identical to those of all chloral derivatives. It is believed that most of the untoward results arising during the administration of medicinal doses are due to impurities,—chlorinated substances,—and, fortunately, such are rare. These are, for the most part, disturbances of respiration, including dyspnœa and partial asphyxia; irregular action of the heart; irritation of the conjunctiva; swelling of the epiglottis and false vocal cords; icterus, increased jaundice; bedsores (rarely); dimness of vision, perhaps even temporary blindness; erythematous, urticarious, and eczematous rashes, etc.

What constitutes a poisonous dose is not known, since so small an amount as 20 grains has induced fatality, while, on the other hand, I have known of the ingestion (by accident) of 480 grains without any ill effects succeeding. Death may arise from cardiac syncope, from paralysis of the respiratory centre with coma and gradual suffocation, or from excessive depression of bodily temperature; a series of cases are recorded in which were evinced symptoms akin to blood-poisoning with purpuric and scorbutic eruptions, ulceration of gums, and great prostration, leading to death.

Treatment of Poisoning.—First, stimulants to the heart and respiration, and, second, attempts directed toward increasing temperature. Strychnine has been heralded as a physiological antidote, because it is antidoted by chloral, but this premise is, unfortunately, not a safe guide; atropine and amyl-nitrite (by inhalation) are more reliable agents; yet strychnine may be valuable as a means of sustaining the action of the heart.

Therapeutics.—In convulsive and spasmodic disorders chloral is undoubtedly one of the best remedies in the materia medica. It has been found useful in asthma (see RESPIRATORY DISEASES); puerperal, infantile, and general convulsions; chorea and epilepsy; tetanus, trismus, whooping-cough, etc.

> Chloral-hydrate is of service in chorea, whooping-cough, trismus nascentium, and puerperal convulsions; it is undoubtedly useful in tetanus. Farquharson ("Therap. and Mat. Med.," '89).
>
> In puerperal convulsions chloral-hydrate is one of the most positive of remedies, but it should be used in large doses. It is a most valuable antispasmodic, and has no equal to prevent spasms. Goss ("Mat. Med., Pharm., and Spec. Therap.," '89).
>
> In tetanus large doses may be given without fear; benefit is also had in epilepsy, chorea, labor, etc. Spender (Bristol Med.-Chir. Jour., Mar., '89).
>
> In a case of eclampsia following abortion chloral (90 grains) by rectal injection caused the convulsions to permanently cease. Free (Times and Reg., Nov. 16, '89).
>
> Butyl-chloral is particularly invaluable in hysteria accompanied by convulsions, and is a specific for whooping-cough. Cawasjee ("Prac. Vade Mec.," '91).
>
> Chloral-hydrate is powerfully antispasmodic and has been used with benefit in infantile and puerperal convulsions, chorea, seasickness, etc.; it is highly beneficial and occasionally curative in tetanus. Excellent results are obtained in whooping-cough. Charteris has obtained good effects from chloralamid in pertussis, chorea, and epilepsy. Whitla ("Pharm., Mat. Med., and Therap.," '92).
>
> Chloral-hydrate may be employed with advantage to arrest uræmic and puerperal convulsions; and in conjunction with bromide is, perhaps, one of the best sedatives in the convulsions of tetanus. in grave cases of epilepsy, in whooping-cough attended with violent paroxysms, and in chorea it is often useful, but in the milder manifestations of these dis-

eases it should not be selected on account of the depressing effect which follows its continued use. Chloralamid combined with bromide is recommended in seasickness. Stevens ("Man. of Therap.," '94).

In tetanus chloral-hydrate is one of the best remedies. It is also employed in infantile convulsions, chorea, rigidity of os uteri, puerperal and uræmic convulsions (if there is no renal trouble present), hiccough, nocturnal epilepsy, and whooping-cough. Hare ("Prac. Therap.," '94).

Chloral has been employed with advantage in puerperal and uræmic convulsions, in tetanus it is claimed to be *the* remedy, is recommended highly in trismus nascentium, and in chorea is sometimes of great advantage. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Chloral is a very useful remedy to overcome spasmodic complications. It is especially valuable in idiopathic tetanus, and cured 17 out of 20 cases at Calcutta. Chorea has been successfully treated with chloralamid; but, as one form of this affection is self-limited in its course, too much cannot be attributed to this drug. Locke ("Mat. Med. and Therap.," '95).

Chloralamid is said to be of great service when combined with bromide of potassium in the treatment of seasickness. Cerna ("Notes on Newer Remed.," '95).

Respiratory and Cardiac Diseases.—The value of chloral and its derivatives in respiratory maladies is not so apparent as in many other classes of diseases, but they nevertheless appear to possess a certain degree of utility, especially in certain forms of asthma, laryngitis, bronchitis, etc.

The effect upon the respiratory centre should suggest caution in prescribing for advanced cases of bronchitis with rapidly-accumulating mucous secretion and deficient oxygenation of the blood. Farquharson ("Therap. and Mat. Med.," '89).

Butyl-chloral is recommended in the irritative night-cough of phthisis in doses of 2 to 5 grains (or less, every half-hour) every hour until 15 grains have been taken. Cawasjee ("Prac. Vade Mec.," '91).

Chloralamid is an excellent somnifacient in heart and lung diseases, and also has been highly recommended as a sedative in cardiac asthma. Stevens ("Manual of Therap.," '94).

Chloralamid has been especially recommended for the relief of cardiac asthma; and the knowledge possessed regarding its physiological action seems to show that the assertions of various clinicians that it is better borne than chloral, in cases where there is cardiac weakness, has a foundation in fact. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Chloralamid is recommended as a sleep-producer for phthisical persons. Locke ("Mat. Med. and Therap.," '95).

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Chloral does not relieve the dyspnœa and cough of disease of the lungs or heart. Hale White ("Mat. Med. and Therap.," '96).

Though chloral has been found useful in angina pectoris, it should be very cautiously administered if there is any reason to suspect valvular disease or degeneration of the heart-muscle. Chloral-ammonium and chloral-urethane do not offer sufficient advantages over chloral-hydrate to justify the use of either as a substitute. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

In the sleeplessness of cardiac and bronchial catarrh chloralamid is particularly serviceable. Its influence upon the circulation is feeble, and not at all injurious; hence it may be employed in cardiac maladies. Biddle ("Mat. Med. and Therap.," '96).

Chloral-caffeine in doses of 3 to $4\frac{1}{2}$ grains may be used hypodermically in asthmatic attacks. Foster ("Prac. Therap.," vol. i, '96).

A full dose of chloral is often useful in a paroxysm of asthma; the shortness of breath, which affects the emphysematous on catching cold, also often yields to its influence. When dyspnœa occurs at night 25 to 30 grains at bed-time calms the breathing and gives sound, refreshing

sleep; but when the difficulty is continuous, 2 to 6 grains should be given several times daily. It is necessary to give the drug with caution to patients with emphysema and bronchitis accompanied by obstructed circulation manifesting itself in lividity and dropsy. Ringer and Sainsbury ("Hand-book of Therap.," '97).

MENTAL DISEASES.—Chloral derivatives undoubtedly have a special value in this class of maladies by reason of their hypnotic action. Chloral-hydrate especially causes sound, refreshing, natural sleep; but no chloral preparation is to be depended upon, save in special instances or when topically applied, as an obtundent of pain.

Chloral-hydrate may be given in simple insomnia from mental worry, overwork, etc., and is a remedy of great value in all diseases in which dangerous depression is apt to follow the continuous want of sleep. Thus, in delirium tremens it must be pushed boldly; in acute mania it may be prescribed with much confidence of success. Farquharson ("Therap. and Mat. Med.," '89).

A valuable remedy in dementia and insanity is chloral-hydrate. Melancholic patients become cheerful under its use, the appetite improves, and the bowels are frequently regulated by it. Gros ("Mat. Med., Pharm., and Spec. Therap.," '89).

Butyl-chloral-hydrate is a weaker hypnotic than chloral-hydrate, and is powerless to relieve pain short of causing sleep, except in case of neuralgia of the fifth nerve; it may be tried in all neuralgic conditions of the face, neck, occiput, and in migraine. Chloral-hydrate is used to combat sleeplessness caused by overwork or worry and in delirium tremens. Chloral-camphor is an excellent application in superficial neuralgias, as is, sometimes, chloral-menthol. Chloralamid acts with tolerable certainty in simple insomnia, but generally fails in moderate doses when pain and excitement are present. Whitla ("Pharm., Mat. Med., and Therap.," '92).

Chloral-hydrate is the purest hypnotic extant, and may, therefore, be used where simple nervous insomnia is present, but not when sleeplessness is due to pain; in paralysis agitans and delirium tremens it is of great service, but must be given cautiously for fear it may depress the heart. Chloralamid is serviceable in the wakefulness of nervous insomnia, in tabes dorsalis, and neuralgia. In facial neuralgia, migraine, headaches due to eye-strain or associated with sick stomach—but not due to gastric indigestion or nervous debility—croton-chloral is useful. Hare ("Prac. Therap.," '94).

The indication which is most usefully met by chloral-hydrate is to induce sleep, and the more purely nervous the wakefulness the more successful the remedy; as a pure hypnotic it is, indeed, unequaled. In delirium tremens it often induces sleep readily, but not rarely fails, even in large dose; in acute mania, puerperal or otherwise, there is abundant testimony as to its value. Chloralamid is an hypnotic slower in action and scarce equal in certainty to chloral-hydrate. H. C. Wood ("Princ. and Prac. of Therap.," '94).

In physical derangements, running all the way from nervous excitability up to delirium tremens, puerperal eclampsia, acute mania and tetanus, in nervous asthma and hiccough, chloral-hydrate is an excellent remedy. Roth ("Mod. Mat. Med.," '95).

In eighty-two cases of insanity a sedative effect was noticed in from fifteen to twenty minutes after taking chloralose; the most satisfactory results were obtained in maniacs, epileptics, and alcoholics. Haskovec (Rev. Neurolog., Oct., '95).

After employing in fifty-eight cases of insanity, general paralysis, senile dementia, and epilepsy, condemnation of chloralose is warranted. Montyel (Rev. de Méd., May, '95).

DISEASES OF KIDNEYS AND GENITO-URINARY ORGANS.—Few seem to be aware of the value of the chloral derivatives in disease belonging to the above classes, and, perhaps, the most startling

claim advanced is the one that accredits chloral-hydrate with being a most valued agent in the treatment of ailments characterized by albumin in the urine. The evidence of its value in uræmia, etc., is to be found under the classification of SPASMODIC AND CONVULSIVE DISEASES.

> In painful menstruation, chloral-hydrate in 10- or 15-grain doses given every three hours often relieves the suffering. The same dose taken at bed-time every night by a patient suffering with gonorrhœa prevents painful erection, and thus wards off chordee. Goss ("Mat. Med., Pharm., and Spec. Therap.," '89).
>
> Chloralamid is an excellent somnifacient in chronic kidney disease. Chloral-hydrate is also a valuable hypnotic, producing quiet and refreshing sleep in the insomnia of chronic nephitis. Stevens ("Man. of Therap.," '94).

SKIN DISEASES AND NEOPLASMS.—Here the chloral preparations have been greatly employed, and not without reason. Chloral-hydrate, it is claimed, if a strong solution is painted on warts and corns, will insure their gradual disappearance. Chloral-hydrate, chloral-ammonium, chloral-camphor, and chloral-phenol have exhibited some measure of value in the management of stubborn skin eruptions, including pruritus and eczema, and are, at least, useful as topical applications in relieving burning and itching. Chloral-hydrate, in 2- to 5-per-cent. aqueous solution is frequently effectual in relieving bromidrosis and hyperidrosis.

CHOLERA AND CHOLERA MORBUS are maladies in which chloral compounds have been employed, but not with such measure of success as to warrant the practitioner's depending upon them solely.

SCARLATINA AND DIPHTHERIA.—In scarlet fever hydrate of chloral is highly recommended in frequently-repeated small doses,—say, 1 to 5 grains, according to age; it has a marked sedative effect, controls inflammation both in throat and kidneys, and even tends to prevent such sequelæ as otitis media and glandular swelling and suppuration. In diphtheria chloral-hydrate or chloral-camphor in suitable solution may be employed as a topical application to the throat and larynx, and the internal administration of the former is often a valuable adjunct to other treatment.

SEASICKNESS.—Chloral preparations are widely advised as a remedy. Though sometimes efficacious, they often prove as futile as others of the host of remedies that purport to be effective.

FEBRILE MALADIES.—It will be readily surmised that chloral preparations, chloral-hydrate especially, may find a place in the treatment of pyrexias, not alone because of its sedative, antiseptic, and hypnotic properties, but also because of its distinct influence upon temperature.

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> Chloral-hydrate possesses to a considerable degree the properties of a typical antipyretic. In sthenic fevers it is an admirable remedy, and deserves far more attention in this direction than it has ever received. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).
>
> Chloral-hydrate is often employed, and very valuably, in fevers, particularly typhoid and typhus, especially where want of sleep, together with delirium, rapidly wears out the strength of the patient. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Other morbid conditions in which chloral-hydrate, and some other of the chloral compounds have been employed with varying measures of success are: rheumatism and sciatica; as a dressing for bed-sores and other ulcers, including suppurating malignant and non-malignant growths, cracked nipples, anal fis-

sure, etc.; as an application to abort felons and boils; for the vomiting of pregnancy; for a purgative action pure and simple; and as a tænifuge in conjunction with male fern and croton-oil. The following is claimed by Bonatti to be a prompt, certain, easily administered drastic purgative, active when even jalap and croton-oil fail:—

℞ Infusion of senna, 10 ounces.
Chloral-hydrate, 24 to 45 grains.
Syrup, 1 ounce.—M.

After the removal of polypi, the application of chloral-hydrate will often destroy the base of the growth. Its internal administration frequently relieves the pain of acute catarrh of the middle ear, and moreover tends to be remedial by checking and reducing inflammation. A 5-per-cent. solution is sometimes useful to remove granulations in the middle ear, especially if the discharge is markedly purulent. The application of chloral-camphor has sometimes proved effectual in assuaging the pain of mastoid disease.

Vesicant Action.—Powdered chloral, sprinkled over adhesive plaster, gently warmed and laid on the skin, makes a speedy, painless, and effective blister, at least equal if not superior to cantharides and more safe as regards children.

Geo. Archie Stockwell,
(Central Staff).

CHLORIDE OF ETHYL. See Ethyl Chloride.

CHLORINE. See derivatives: Potassium Chlorate, Sodium Chloride, etc.

CHLOROFORM. — This well-known anæsthetic was simultaneously discovered, in 1831, by Guthrie, of the United States; Soubeiran, of France; and Liebig, of Germany. Dumas later on gave it its present name, and Sir James Y. Simpson, of Edinburgh, first used it as an anæsthetic.

Chloroform ($ChCl_3$; specific gravity, 1.497 at 62.5° F.) is a terchloride of formyl, obtained by the action of chlorine upon alcohol, the methods usually employed being either the addition of chloral-hydrate to an alkaline solution or of chlorinated lime to ethyl-oxide. This is distilled and subsequently purified by the addition of sulphuric acid, sodium carbonate, and lime, and redistillation is then resorted to.

Chloroform appears as a neutral, colorless fluid, possessing a sweetish and hot taste, and giving off a fragrant and characteristic odor. It possesses marked solvent powers, rapidly dissolving alkaloids, iodine, bromine, volatile oils, etc.; but is itself only sparingly soluble in water. It is distinctly so, however, in alcohol and ether.

Chloroform is not inflammable under ordinary circumstances, except when mixed with alcohol. When used, however, in the presence of a gas-flame, it is likely to become decomposed, and the product may prove noxious to the persons inhaling it.

Chloroform-vapors are broken up into chlorine and carbonic oxide by gaslight, causing bronchial irritation in those present, asphyxia in the patient, and even death. Herson-Leidon (Deutsche med. Woch., Apr. 3, '90).

Hydrochloric acid and carbon dioxide, and not monoxide, are the toxic agents. Kunkel (Münch. med. Woch., Apr. 4, '90).

A coal-gas flame in an ill-ventilated room and a somewhat prolonged exhibition of chloroform may, by forming a compound with the latter, induce serious symptoms in patient, surgeon, and assistants. Illustrative instances. Charles G.

Lee (Liverpool Medico-Chir. Jour., July, '95).

Identical effects observed. Irritating agent, a carbon-oxychloride, or phosgene, discovered by Sir Humphry Davy. Paterson (Practitioner, vol. xlii).

Warning against use of chloroform near a gaslight, — ethylene-chloride formed. In tabetic patients fatal coma may be induced. Rehn (Le Bull. Méd., May 12, '95).

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Case of a man shot in the abdomen, who was brought to the hospital at night and immediately operated upon by gaslight. As a result of the chloroform narcosis, which had to be kept up for four hours, powerful chlorinated vapors were produced. Two of the surgeons and several of the Sisters of Mercy were overcome and one of the latter has since died. (Inter. Med. Mag., Apr., '98.)

Even under ordinary conditions the chloroform usually employed for anæsthetic purposes tends to decompose and to form hydrochloric acid and carbonyl-chloride. According to Newman and Ramsay, this latter substance is the cause of the majority of cases of after-sickness. This can be overcome by keeping a little slack lime in the bottles and filtering in the supernatant liquid as required.

The deleterious effects of chloroform become especially manifest when kept in a bottle containing air and exposed to light.

Physiological Effects and Contra-indications.—The conclusions of Lawrie and of the Hyderabad Commission, the principal of which is that failure of respiration is the only possible way by which death is produced by chloroform, has now run the gauntlet of several years' criticism and may be said to no longer be accepted by the profession, and especially by experienced anæsthetists. Indeed, many competent observers have reported cases in which the heart ceased before the respiration, and Mr. Leonard Hill has recently expressed the view that the cause of chloroform collapse was in all cases a primary failure on the circulatory mechanism, the respiration failing secondarily on account of the anæmia of the bulbar centres. He had examined all the tracings taken by the Hyderabad Commission, and found that in them (although it was not so interpreted by the experimenters) the same typical fall of arterial pressure actually occurring before the cessation of respiration observed by him elsewhere. Thus their own experimental evidence contradicts the conclusions arrived at by the workers on the said commission.

A correct view would probably include both factors: a conclusion which Horatio C. Wood reached eight years ago, when he said: "If any evidence is to be attached to the statements of competent witnesses it is certain that in some cases, under the influence of chloroform, the pulse and respiration have ceased simultaneously, while in other instances the respiration has ceased before the pulse, and in still other cases the pulse has ceased its beat before the respiratory movements were arrested." Lauder Brunton has since given precision to our knowledge by an exhaustive study of the question, which led him, in the main, to believe that cases of simple danger without death were due to failure of respiration, while death was brought about through arrest of the heart or arrest of the heart and respiration together (neuroparalysis); furthermore, that the most common cause of neuroparalysis, as found by Casper, was strangling (as in drowning), which kills by neuroparalysis as often as by asphyxia.

The weakening effect of chloroform on the heart is the chief, if not the only, cause of the fall of blood-pressure seen

upon administration of the drug; it is difficult to understand how the Hyderabad Commission could have arrived at their conclusion, as a large number of the curves point directly to heart-failure as the cause of the fall of blood-pressure. Shore and Gaskell (Brit. Med. Jour., Jan., '93).

Earliest effect of overdose is arterio-capillary contraction, which exerts a kind of stop-cock action to prevent blood dangerously loaded with chloroform from reaching tissues. Heart, itself depressed by anæsthetic, has not sufficient power to go through its systole in the face of the resistance in front. J. M. Marsh (Lancet, Dec. 7, '95).

[Variations in circulation due not only to the above various factors, but also to alterations effected by chloroform in the central nervous system and local nervous mechanisms. As shown by Waller, electrical reaction is profoundly altered by anæsthetics; hence distinct danger in conditions of nerve-prostration and post-influenzal neurasthenia. The whole question of reflex inhibition of the heart under chloroform bristles with difficulties. If fear were simply the cause, such cases would occur often under ether, as that substance, when badly given, produces more terror, breath-holding, and struggling than chloroform; and yet ether seldom, if ever, kills in this way. Unquestionably, chloroform — whether through poisonous effects on protoplasm or in some other way—exerts some deleterious influence upon tissues of patients, which renders them less able to withstand any unusual strain imposed upon them. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

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The truth of the question as to whether chloroform causes death by respiratory failure or cardiac failure lies, as it were, half-way between the two antagonistic forces; and, further than this, the somewhat startling statement may be made that it is not directly due, in the majority of cases, to either of these causes. On the contrary, the cause of death from chloroform is usually vasomotor depression, whereby the arterioles allow the blood to pass too freely into the great blood-vessel areas, and, as a result, the man is suddenly bled into his own vessels as effectually as into a bowl. H. A. Hare (Therap. Gaz., Feb., '97).

Lowered arterial pressure has a comparatively feeble effect upon the respiration, but, when the pressure falls sufficiently, respiratory depression does occur. Even excessive lowering of blood-pressure primarily stimulates the vasomotor centre, the sensibility of the centre being evidently necessary to the automatic regulation of the circulation. Hence it is evident that the depression of the circulation produced by chloroform has effect upon the respiratory centres only when the pressure has fallen very low, and, while it may be a factor in the production of respiratory failure during chloroformization, the failure must be chiefly due to the direct influence exercised by the drug upon the respiratory centres. H. C. Wood and W. S. Carter (Jour. of Exper. Med., May, '97).

Arrest of the heart is one of the most important causes of collapse during chloroform anæsthesia. The paralysis of the vasomotor centre which is provoked by the latter brings about the rapid fall of the blood-pressure, and this fall, by depriving the cardiac muscle of its excitant, is one of the causes of the arrest of the heart. Evenhoff (Vratch; Union Méd., July 11, '97).

The principal danger from chloroform anæsthesia is the sudden syncope from cardiac paralysis, which is as likely to occur in strong as in weak subjects; it happens more frequently at the beginning than at the end of anæsthetization, presents conditions of the greatest difficulty for treatment, and frequently results in death. In view of these conditions, although the superiority and greater convenience of chloroform in certain cases of cerebral surgery, operations on the respiratory passages, etc., may give it preference, its adoption as a routine anæsthetic ought to be condemned. Editorial (Boston Med. and Surg. Jour., Aug. 26, '97).

The heart also shares the brunt of responsibility with the respiratory tract

as far as contra-indications are concerned; but if the operator bears in mind the fact that, the nearer muscular integrity of the organ is discerned, the greater the safety, he will at once have a key to the lesion which may prove the basis of complications. Fatty degeneration and dilatation are the main conditions to fear, because the cardiac walls are the most compromised and may not be able to resist the engorgement resulting from increased arterial pressure.

Valvular lesions only increase the danger if they are obstructive. In that case, even, compensative hypertrophy may also compensate for the extra resistance induced.

In aortic insufficiency, as emphasized by Giffen, it is necessary to study heart-rhythm and arterial pressure. So long as the rapidity of the heart's action does not disturb the rhythm—viz.: first sound, second sound, pause—within reasonable physiological limits, or, in other words, the arterial pressure (composed of the time [rapidity] and intensity [muscular impulse]) does not overcome rhythm, the anæsthetic can be given without increased danger.

Literature of '96 and '97.

Results obtained in two hundred cases of chloroform administration in which the heart was auscultated with the binaural stethoscope, then with the phonendoscope, connected with the upper half of a binaural, and having a watch fitted in. Most marked changes occur at the beginning of inhalation, soon after inhalation is stopped, or within a minute after retching or vomiting. Susceptibility on the part of the patient seems to play an important rôle.

Indications of dangerous idiosyncrasy: Forcible impulse of the heart, with loudness of one or both sounds; irregularity of the heart before inhalation; and liability to tachycardia or irregularity during inhalation, which may, through fear, return in a worse form during elimination.

Two faults to be avoided during the administration of the chloroform: First, the fault of stopping in superficial anæsthesia; second, that of exhibiting an unnecessarily-strong vapor at the very first. By avoiding these, evil effects on the heart would be reduced to a minimum. To determine whether we attain this object we must avail ourselves of the help of the phonendoscope. Robert Kirk (Brit. Med. Jour., Dec. 12, '96).

Disorders of the respiratory tract are as liable to compromise the issue as any grave cardiac disease. Great caution should be observed in the administration of chloroform in all asphyxial conditions,—*i.e.*, when the respiratory area is to any degree restricted through the presence of growths, pyæmic accumulations, emphysema, etc. In scrofulous children the presence of enlarged bronchial glands is to be surmised, and the anæsthetic should be administered with unusual care. In affections complicated by liquid effusions, however, the danger may be thwarted when it presents itself.

Case showing what timely evacuation of contents of pleura will do in such cases. As soon as evidences of asphyxia showed themselves the skin was divided with one cut of bistoury and the pleura was instantly opened and pus evacuated, the almost moribund patient quickly returning to life. Guermonprez (Jour. des Sciences Méd. de Lille, May 4, '95).

Langlois and Richet have shown by experiments on animals that in surgical anæsthesia extreme care should be taken that the movements of expiration be not interfered with. This might be extended to expiration, likewise, and the necessity of protecting the *via vitæ* against the ingress of mucus, saliva, blood, etc., thus emphasized.

Attention has been called to the importance of examining the urine, especially for albumin, before subjecting a

patient to a general anæsthetic, and particularly in subjects of middle or advanced age, whose appearance suggests the presence of renal disease. Whether the presence of albumin in the urine should prohibit any surgical operation is a mooted point. Snow laid it down as an axiom that, if an operation must be performed, however serious it might be, the administration of an anæsthetic was justifiable, on the whole, and that rule has been pretty generally adopted without any manifest bad results. Benjamin Ward Richardson, referring to the above, stated that he had administered ether, chloroform, and methylene to great numbers of persons suffering from albuminuria, without any untoward results.

The marked increase of albumin noted in albuminuric cases and the presence of it in cases which had not shown any before the administration of the anæsthetic shown in the following abstracts, nevertheless counsel prudence.

It seems obvious that renal lesions can but cause increased blood-pressure, and thus tend to enhance the likelihood of cardiac syncope, and that, when kidney lesions are known to exist, chloroform should be administered with unusual precaution.

While effects of chloroform on kidneys are practically *nil*, in patients with renal affections this safely cannot be said to exist. The necessity of carefully observing urinary secretions one or two days before administration of chloroform emphasized. When renal lesions exist, chloroform should be avoided or given with greatest caution. Allessandri (Med. and Surg. Reporter, June 8, '95).

The presence of renal disease very greatly increases danger of administering anæsthetics; no surgeon should think of undertaking such procedures until after urine has been carefully examined on a number of successive days. Chloroform is the anæsthetic of election in the face of renal complications. Editorial (Ther. Gaz., Mar. 15, '95).

It is possible to tell, by examining the urine of patients before taking chloroform, whether they would have any troublesome symptoms. When an excess of alkaloid is present in the urine there is a tendency to cessation of respiration; this does not occur when the amount of alkaloid present is slight. Poehl (Proceedings Royal Medico-Chir. Soc., vol. vi, p. 147, '94).

The urine of one hundred male patients studied before and after chloroform narcosis. The alteration of the kidney is a tissue-lesion which removes the power of inhibiting the loss of serum-albumin, the causes of which lie in the poverty of oxygen in the blood, the destruction of blood-corpuscles by the chloroform, the injury to the tissues by the liberated chlorine, and, lastly, the lowering of blood-pressure. As evidence for the occurrence of a tissue-lesion, the fact was adduced that in 44 out of 56 cases investigated upon this point, after narcosis, the urine contained nucleo-albumin. V. Friedländer (Viertel. f. ger. Med., Dritte Folge, B. 8, Supplement, H., p. 94).

Of 42 male patients, 3 suffered from albuminuria previous to chloroformization, while the other 39 were healthy. After the chloroform the 3 albuminuric patients showed more albumin, while the others presented albuminuria lasting from 1 to 14 days. Sokoloff (Wratsch, No. 4, '91).

After prolonged chloroform narcosis in healthy persons there is prolonged disturbance in metabolism of albuminous substances. Kast and Mester (Zeit. f. klin. Med., vol. xviii, '95).

Literature of '96 and '97.

Result of a study of two hundred and fourteen cases of chloroform anæsthesia in which the urine was carefully examined. Albuminuria occurred in 80 per cent. of the cases, lasting from two to six days. Sugar and acetone were never found. In 60 per cent. casts were present, mostly hyaline, but also a few epithelial and granular. All degrees of changes were found in the kidneys, from

single hyperæmia and capillary hæmorrhages to extensive coagulation necrosis of the renal epithelium. K. Ajello (Monograph, Milan, '96).

Examination of the urine in 130 cases of anæsthesia,—60 from ether and 70 from chloroform. In 8 cases out of 13 in which there was albumin in the urine before the anæsthesia there was an increase of the albuminuria: 4 times after ether and 4 times after chloroform. Eisendrath (Deut. Zeit. f. Chir., B. 40, '96).

Effects of ether and chloroform narcosis on the kidneys. In 29 per cent. of the cases after etherization albumin was found in the urine, and in 18.89 per cent. after chloroform narcosis. In each case the urine before the operation was free from any trace of albumin. The etherized animals showed renal alterations consisting of diffuse hæmorrhagic nephritis, with preponderating glomerulitis and multiple renal hæmorrhages. The superiority of ether over chloroform from the point of view of safety is shown. Babacci and Bebi (Il Policlinico, May 1, '96).

Examination of the urine of 54 people after chloroform anæsthesia, and of 41 cases after ether anæsthetization. Narcosis in chloroform cases lasted, on an average, 57 minutes, and in the ether cases one and a half hours. There were 10 cases of albuminuria and cylindruria after chloroform; 15 cases after ether. In 3 of this last series there was preexisting kidney disease. Autopsy in 2 ether cases showed hæmorrhagic nephritis affecting especially the glomeruli. Albumin is more frequently observed in the urine after ether than after chloroform, but the nephritis caused by ether is transitory, while that due to chloroform is likely to become chronic. Legrain (Ann. des Mal. des Org. Genito-Urin., No. 2, p. 191, '97).

The inhibiting influence of chloroform narcosis upon general metabolism has been considered as a prominent factor in the etiology of untoward phenomena, and Guthrie and Kiefer have ascribed some deaths occurring some days after the administration of the anæsthetic to defective elimination of excretory products. Casper, Behrend, Langenbeck, and other authorities have shown that chronic chloroform poisoning does actually occur; and Guthrie ascribed to autointoxication: either a fatty condition of the liver (and, therefore, functional disturbance of the organ) existing before the anæsthetic was given, or to chloroform and operation-shock combined, which aggravated the condition already present. It is supposed that lessened oxidation, such as some believe ether and chloroform can cause, leads to deposition of fat in the liver and elsewhere, and so would prevent fat being oxidized on its way from the liver into the general circulation.

Ungar, Strassmann, and other observers have also found that fatty changes could be induced in the liver through the influence of chloroform upon the blood-vessels and tissue-cells. As a result, the urine becomes loaded with alkaloidal bodies which the kidneys cannot eliminate with sufficient rapidity. Hence the autointoxication.

As a result of chloroform narcosis there are present fatty degeneration of organs, especially fatty infiltration of the liver and fatty changes in the cardiac and skeletal muscles, kidneys, and stomach; these fatty changes arise from the action of chloroform upon the blood-corpuscles and tissue-cells. Some subjects show a greater susceptibility to these effects of chloroform than others. Chloroform is contra-indicated in all cases of fatty liver; when this condition is not discoverable by clinical evidence, the fact that the liver-function is hampered — as shown, for example, by alkaloidal bodies in the urine—should be taken as contra-indicative to chloroform. Ungar and Strassmann, Thiem, and Fischer (Deutsche med. Zeitung, p. 4, '89); Ostertag (Virchow's Archiv, vol. cxviii, p. 2).

Lessened oxidation, such as some believe ether and chloroform cause, leads to deposition of fat in the liver and elsewhere, and so would prevent fat being oxidized on its way from the liver into the general circulation. Guthrie (Lancet, Jan. 27, Feb. 3, '94).

After death from chloroform there is a decided acid reaction of the fluids and tissues, and the lessening in alkalinity actually occurs during chloroform inhalation. Taken in connection with the researches of Kast and Mester, showing that fatty degeneration follows prolonged inhalation, this possibly explains the lethal effects that chloroform exerts on the cells. The urine, further, has its acidity increased after chloroform. It would appear as if the acid excretions of the working-muscles, etc., usually readily neutralized by the cells (Langendorff), are left unaltered, or are imperfectly neutralized during chloroform inhalation. Mansfelde (Omaha Clinic, Sept., '92).

Method of Administration.—*Position.*—The position of the patient bears an important influence upon the results. When the splanchnic vasoconstrictors are paralyzed by injuries or poisons, such as chloroform, the influence of gravity becomes manifest, as shown by Leonard Hill, owing to dilatation of the abdominal veins with corresponding emptying of the heart and cessation of cerebral circulation; hence the numerous accidents reported witnessed in the dental position; that is to say, that employed by dentists for the removal of teeth. Death in sitting posture occurs from sudden cessation of the heart's action, through abdominal engorgement and depletion of cerebral vessels.

Two cases in which, through extensive injuries of cranium, large areas of brain proper were exposed. Under prolonged anæsthesia, chloroform reduced cerebral circulation. In one case in which the local hæmorrhage was severe the latter subsided as soon as patient was fully under anæsthetic. Bedford Brown (Ther. Gaz., Dec. 15, '94).

The use of chloroform and ether is always dangerous in ordinary dental surgery, and is unjustifiable. Nitrous-oxide gas is, by far, the best dental anæsthetic. H. Sewill (Archives of Otology, Dec. 8, '94).

For operations about the mouth or throat full extension of the head upon the trunk, while the patient is lying down, answers admirably, but, as shown by Buxton, it produces some congestion of the head and neck vessels, which in certain subjects induces a very undesirable amount of bleeding. If the extension is not exaggerated, however, and if the head is supported beyond the edge of the table so that the traction upon the anterior portion of the neck through an excessive extension is not too great, the abnormal bleeding can be avoided. For the removal of adenoid vegetations this position is of value. In the illustration shown herewith, while the general position of the patient is, on the whole, the proper one, the head is unduly forced downward. A small pillow or three or four towels adjusted to the edge of the table to support the head somewhat higher would place the patient within easy reach of the surgeon and at the same time avoid the danger of excessive bleeding.

For operations in the vault of the pharynx, as in the case of adenoid growths, the blood is thereby prevented from flowing in the direction of the larynx: an element of danger, in many cases, when the position of the body is on a line to that of the region operated upon.

Dudley Buxton calls attention to the fact that the lateral position, recommended by many, is by no means possible in stout persons, while short-necked subjects also bear this position badly. He prefers to place a pillow well under the shoulders, giving just sufficient ex-

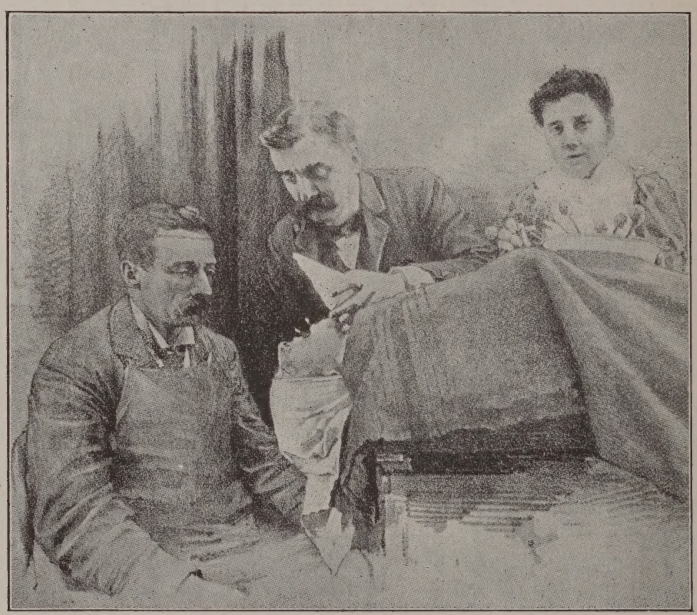
tension of the head upon the trunk for practical purposes. This position I have found a most advantageous one in operations about the posterior nasal space.

A certain amount of care must be taken when the head is not fully extended, however, that the tongue, during the deep stage, be not allowed to fall back against the pharynx and thus tend to occlude the respiratory area. Howard, in 1888, showed that the most effectual way of opening the air-passages was by forced extension of the head upon the trunk, thereby raising the epiglottis and tongue; but this does not prove true unless excessive extension be resorted to; and, as this is inadvisable, the benefit of Howard's method is not obtained.

The usual cause of death in surgical anæsthesia is due to the valve-like action of the epiglottis, which, falling backward, completely closes the laryngeal opening, rendering abortive all efforts at artificial respiration. Consequently full extension of the head must be obtained by bringing it to the edge of the table, and extending it backward and downward as far as possible. Benjamin Howard (Brit. Med. Jour., p. 1455, '88).

Objection to Howard's method on the ground that by it the soft palate is strapped tightly over the dorsum of the tongue, so that the patient has to depend for air upon the nasal passages, which are scarcely sufficient at best, and are subject to all degrees of obstruction by congestive swelling or abnormal formations. The obstruction caused by the epiglottis or base of the tongue is best removed by pushing forward the lower jaw by force applied from behind and moderately extending the head. Martin and Hare (Med. News, Mar. 2, '89).

Howard's method found to impede respiration by experiments upon my own person. Weir (Med. Rec., Feb. 23, '89).



Position for the removal of post-nasal growths. (*Kendal Franks.*)
(Dublin Journal of Medical Science, Mar., '95.)

Influence of Atmospheric Conditions.—Benjamin Ward Richardson attached much importance to the condition of the surrounding air as a cause of danger. When the air is surcharged with moisture the chloroform condensation in the pulmonary air-cells and its subsequent entrance into the blood are impeded; the stages of narcotism will, by this, be prolonged. Recovery is also slower. Syncopal attacks in a moist atmosphere are more likely to terminate fatally. Again, the moisture which should escape from the air-passages cannot do so when the atmosphere is too saturated, and the tendency to waterlogging of the lungs under chloroform is increased.

The temperature also bears a marked influence when it is high, the volatilization is more rapid, its diffusion and condensation are increased, and both the onset and the recovery are more rapid. The safest temperature is 60° to 70° F.; a higher rather than a low range is best.

Literature of '96-'97-'98.

Chloroform anæsthetization under varying atmospheric pressures: The action of chloroform is more rapid but less lasting if the atmospheric pressure is reduced. The elimination of chloroform by the lungs is much more rapidly effected in animals subjected to very low pressures. Benedicenti (Archives Ital. de Biol., vol. xxiv, No. 3, '98).

Preparation of the Patient.—The patient should be in an entirely-loose garment and in the recumbent position. A quiet, well-ventilated, and well-lighted room should be selected.

Any foreign body, such as false teeth, tobacco, or any accumulation of mucus, should be removed from the mouth, naso-pharynx, and nasal passages.

All solid food should have been withheld for at least four hours and no liquid food for at least two hours before the administration of the anæsthetic, although a small quantity of brandy or whisky may be given a few minutes before if the patient be at all debilitated.

[This recommendation is of the greatest importance, for the regurgitation of food when the patient is under the anæsthetic may, by entering the larynx, cause asphyxia. SAJOUS.]

The patient's fear should, as much as possible, be allayed by kindly and encouraging words, death being sometimes caused by heart-syncope, resulting from fright. A show of surgical instruments should be avoided.

If the operation is at all to be prolonged or be of such a nature as to cause severe pain in the waking state, an hypodermic injection of morphine, $^1/_4$ grain, should be administered twenty minutes before the chloroform is given.

Administration and Dose.—As in the case of other agents, it is obvious that the purest chloroform obtainable should be employed. Many instruments were devised for the purpose of administering anæsthetics in general (the principal ones will be described under ETHER), but these are seldom employed outside of hospitals. Except under certain conditions, when the anæsthetic is administered in the presence of gaslight, the simplest way to apply chloroform is on a towel or handkerchief; or a cone or funnel may be made with a folded towel into which the anæsthetic may conveniently be dropped.

On account of its irritant action, chloroform should not be allowed to come into contact with the eyes or face. In the case of a fair-skinned female patient, it is advisable to apply vaselin or cold cream where the chloroform-vapor is likely to touch the skin.

A drop-bottle should be employed for the anæsthetic, the pouring-out method

usually employed being a dangerous procedure.

The patient lying upon his back, his chest is bared, a compress placed over his mouth, and 2, 3, or 4 drops of chloroform poured upon it. The compress or cone is held so as not to close completely the nostrils and mouth, thus enabling the patient to inhale well-diluted vapor at first. In fifteen seconds the chloroform will have evaporated, when 4 or 5 drops more are then allowed to fall on the centre of the compress, this being turned rapidly so as to avoid an excessive intake of fresh air. This manœuvre is repeated about every half-minute. When narcosis is complete, 2 or 3 drops of the anæsthetic are used every minute.

Coughing indicates that the air inhaled is too heavily charged with chloroform-vapor, while struggling in the first stage tends to show that the patient is feeling the want of air—a terror-inspiring sensation.

> [Never induce slow narcosis through every stage, but, having carefully felt the way in the first minute or two, push quickly into the third stage, in which, if the body be not surcharged with chloroform, the danger is comparatively small. DUDLEY BUXTON, Assoc. Ed., Annual, '93.]

> A given percentage (below 5) of chloroform is always safe. Narcotism is throwing certain systems of the body into a lethal state, and systemic death is escaped or follows according as the vital centres, still capable of involuntary organic work, are or are not sound. Richardson (Asclepiad, Jan., '92).

The extreme danger of rapid chloroformization was repeatedly emphasized by Richardson, who argued that fatal results follow upon the sudden impact of chloroform—an irritant vapor — upon the nervous periphery of the breathing-surfaces. (See influences upon the nasal mucous membrane, *infra*.) This sudden impact causes, in his opinion, a contraction of the pulmonary arterial vessels; thence results ischæmia of the lungs and overfilling of the right heart, leading to cardiac stand-still. A few minims of chloroform injected into a vein kills the heart-muscle outright and beyond recovery. If the animal is healthy the lungs prevent such a catastrophe when the chloroform is inhaled; but the author contends that when the heart is not healthy the lethal dose may be so small that it may pass through the lungs and reach the heart, causing fatal syncope. While gradual, rather than rapid, chloroformization (two minutes for infants, three for children, and four or five for adults—Snow) is recommended, the danger is urged of overcaution, as the blood grows highly saturated with chloroform before anæsthesia is obtained, and the organs and tissues are so saturated with chloroform that, should any causal accident arise, it is fatal in spite of all efforts to withdraw the chloroform from the blood, since reabsorption into the blood takes place from the tissues.

To settle this question Kionka conducted a series of researches to determine quantity of ether or chloroform necessary to produce narcosis. He found the dose required to be relatively small. Narcosis was obtained when the air contained from 0.15 to 1.3 per cent. of chloroform, or 2.1 to 7.9 per cent. of ether. The minimum quantity of ether necessary to produce anæsthesia could be greatly exceeded without endangering life, and narcosis could be prolonged by using the same dose, while, under similar conditions, chloroform invariably caused death of the animal. Sleep under ether, when once established, could be maintained with a smaller dose than that required to produce it. From the begin-

ning chloroform caused early arrest of heart and respiration.

Robert Bell has noted that the symptoms of approaching danger under chloroform always appear in the following order: (*a*) coughing, (*b*) gasping, (*c*) choking, and (*d*) struggling. If, at the first appearance of coughing, the vapor is given more diluted, no further difficulty will arise. On the other hand, W. A. Parker ascribed the small number of deaths observed in Scotland to the fact that the anæsthetists are not afraid of chloroform; they use it fearlessly in unstinted doses, pushing the patient rapidly under.

Buxton states that there seems every reason to believe that an overdose of chloroform may be arrived at in one of two ways: (1) a sudden intake of a lethal dose, which, according to Sansom, who followed Snow's emphatic teaching, may be taken when even a small quantity of the anæsthetic is thrown on lint or a towel, or (2) through accumulation of the drug in the body. This commonly shows itself by paralyzing the medullary centres and so producing cessation of respiration. Impairment of *expiration* is the most usual cause of this, due in many cases to some mechanical cause, such as emphysema, falling back of the tongue, sucking in of the lips, or blocking of the air-ways by mucus or blood.

As regards the lower mortality reported from Scotland, Buxton argues that many deaths under chloroform have occurred in that country; even as early as in the days of Simpson. As no public investigation is held corresponding with coroners' inquests, as is the case in England, no report gets into the public press. He reaches a conclusion sustained by experience, and verified by a wide-spread review of the literature, to the effect that *every individual requires a specific dose: the drunkard and athlete require much; the pale, frail, anæmic woman very little.*

> The dose should be regulated by the age and constitution of the patient as well as by the duration of the operation. To maintain anæsthesia when once established requires but little additional chloroform. Kappeler (Deutsche Zeit. f. Chir., vol. xxxvi, p. 24, '93).

Literature of '96-'97-'98.

> A patient may take in a sufficient quantity of chloroform-vapor in one or two deep inspirations, over which the anæsthetizer has no control, to endanger the centres of respiration. The secret of safe administration is a very gradual increase supplied to the patient while putting him under. Once the patient is under, the amount must be reduced to the minimum, continuing to supply him constantly; anæsthesia may thus be maintained continuously for hours with perfect safety. Arnold (Brit. Med. Jour., Dec. 12, '96).
>
> Experimentation through the past ten years has shown that the quantity is the all-important factor in anæsthesia and in death by chloroform. The continuous administration of a mixture of chloroform and air at an average percentage of 1.5, not below 1 per cent. and not above 2 per cent., required. The so-called uncertainty and danger in chloroform administration is an uncertainty in the quantity administered. A. D. Waller (Brit. Med. Jour., Apr. 23, '98).

The stages of chloroform narcotism as given by Snow and Buxton are divided into four:—

The *first* stage, from the commencement of inhalation to the loss of conscious control of the limbs.

The *second*, to the stage of loss of conjunctival reflex and rigidity of the muscles.

The *third*, or surgical stage, when the muscles are relaxed (in the main), the corneal reflex is lost, and the pupil is contracted.

The *fourth* stage, when the medullary centres are affected, the pupils dilate, the respiration gradually fails, the muscles are absolutely relaxed, the sphincters cease to act, while the circulation fails.

Beyond this stage convulsions occur, the breathing ceases, and the heart and circulation come to a stand-still. The complete relaxation of the muscles can, in some cases, be arrived at only by the patient's entering the fourth stage, and, in the case of chloroform, such pushing of the anæsthetic can only be accomplished by seriously jeoparding the patient's life. In the case of ether, however, a patient can, with ordinary care, be allowed to pass into this stage without danger.

At all times during the administration of the anæsthetic *the respiration and the circulation should be simultaneously watched.*

Untoward Effects.—The chances that no trouble will be met with stand as 1500 does to 1, provided average care has been taken in determining whether the case be not one offering unusual chances against a successful administration. But in *all* cases certain allowances must be made not only for previously-undiscovered elements which may suddenly bear their influence upon the issue, but also for known conditions which also modify the form of issue.

Owen states that there is always risk in giving chloroform or any other anæsthetic to a child; but this risk is diminished in proportion as the vapor is administered in a careful manner and by a well-instructed person. It is important to bear in mind, in this connection, that the general impression that children very rarely succumb to the influence of chloroform is erroneous. The many deaths in children ranging from early infancy to 15 years of age have served to emphasize this fact.

On the other hand, the fear that untoward results will follow the use of an anæsthetic in patients of advanced age is equally exaggerated, as shown by a large series of cases reported in which no unusual effect was witnessed. Heath, for instance, administered chloroform to a woman 94 years old, to reduce a dislocation. The patient bore the anæsthetic calmly and easily. Indeed, acute suffering is a prolific source of fatal shock in old people, and anæsthesia thus becomes a life-saving agent in them.

As regards the increased liability to untoward effects through disease, Reynier recently showed that, according to the more or less great resisting power of the various cells affected during the anæsthetization, are fatal accidents liable to occur. While in alcoholics, whose cerebral cells are in a continual state of hyperæsthesia, delirium is observed, which may reach the stage of delirium tremens; but in these, also, heart-wall degeneration is probable, and early syncope is likely in proportion. In hysterical subjects all varieties of hysterical attacks may occur, even paralysis and syncope. The same is the case in epileptics. In morphinomaniacs only slightly intoxicated chloroformization is easily and rapidly accomplished; in others, on the contrary, it is more dangerous. In ataxic subjects the period of medullary excitement nearly always gives rise to reflexes which may arrest the respiration and heart-movements.

To these morbid conditions must be added those enumerated and involving the circulatory, respiratory, and urinary systems, and prolonged abdominal operations, strangulated hernia in old and exhausted subjects, colotomy and colectomy, etc.

Extra watchfulness should be observed in *all* such cases, and shock anticipated by preliminary measures: stimulants, strychnine, etc.

Shock. — Murray-Aynsley emphasized the fact that many deaths under chloroform occurred within a very short time after the commencement of inhalation, or when comparatively trifling, although painful, operations were to be performed (extraction of teeth, etc.) were due to *shock* during *imperfect anæsthesia.* He denies that the experiments performed by the second Hyderabad Commission prove that shock under chloroform was not competent to produce syncope, as in them painful operations were performed on animals coming out of chloroform, and in a condition where, as he contends, analgesia persisted, although anæsthesia was imperfect.

Closely connected with the production of shock is *fear,* which tends greatly to increase the chances of cardiac syncope, through the exaggerated functional tension induced. White has shown that even a small amount of chloroform is capable of inducing a fatal issue under these circumstances. There is a marked difference in this particular between Europeans and Hindoos: a fact which has served to markedly decrease the mortality of anæsthesia in India.

Investigations by means of the arteriometer demonstrate that shock, as shown by the phenomena of the circulation, is variously affected by different anæsthetics. A diminution in the calibre of the artery accompanies shock, and is the result of a fall in pressure, the fall lasting, with but slight fluctuations, throughout the administration. George Oliver ("Pulse-gauging," '95).

Functional high tension is of great importance; it is often due to fright, and threatens grave danger. The first sound is most worthy of study in this connection. If its duration is shortened, or if it is sudden, it betokens an incomplete, hurried, irregular muscular contraction of the heart, and signals danger. Foxwell (Brit. Med. Jour., Dec. 31, '92).

Literature of '96 and '97.

Aside from pathological conditions, the patient's nervous organization ought to receive careful consideration, for it is unquestionably true that patients have been literally scared to death, and the first few whiffs of chloroform have had a lethal effect in many cases. A. H. Meisenbach (Northwestern Lancet, Mar. 15, '96).

Too prolonged a fast prior to taking chloroform is considered dangerous by Murray-Aynsley. Christopher Heath, when an operation is likely to be very prolonged, administers an enema of hot beef-tea, half an hour before the administration. Silk has recommended the "hospital regimen" for some days before the operation.

Stimulants were advocated even by B. W. Richardson, who gave alcohol in definite doses, twenty minutes before the inhalation.

Formula:—

℞ Tinct. chloroformi, 1 drachm.
Spir. tenuior, 1 ounce.

This was given in water and sweetened if preferred.

Foxwell also gave alcohol when the heart was not orderly and calm five minutes before beginning the administration of the anæsthetic, but opium, given two or three hours before, he considered even better.

Literature of '96 and '97.

Oxysparteine hydrochloride is more energetic than sparteine in sustaining the heart's action under the influence of chloroform. A subcutaneous injection of from $^4/_{10}$ to $^6/_{10}$ grain, together with $^1/_6$ grain of morphine hydrochloride, about an hour before the operation, reduces the amount of chloroform that has to be

used, and the action of the heart remains regular and strong, even if the respiration becomes somewhat shallow. Langlois and Maurange (Ther. Woch., Apr. 12, '96).

Too little importance is usually attached to *struggling,* which, according to Lawrie, is produced (1) by fright, leading to purposeful resistance; (2) by choking or asphyxia from overconcentration of the vapor, owing, generally, to the cap being held too close to the face at first or afterward when the chloroform is being renewed; and (3) by intoxication,—*i.e.,* the so-called "struggling stage." Dudley Buxton considers the struggling of intoxication as extremely dangerous. The breathing is then irregular and the amount of chloroform in the circulation is considerable, anæsthesia being nearly complete: factors markedly increasing the changes of cardiac syncope and general toxæmia.

The inhaler should be removed from the face for a few respirations, which does not necessarily cause a break in the narcosis, as chloroform still remains in the air-cells; and, as soon as respiration has resumed its normal character, the chloroform is reapplied.

Certain regions are especially prone to encourage cardiac syncope when submitted to *rough handling* in surgical procedures. Traction upon the omentum and undue manipulation of the intestines and other viscera are probably the most active factors of this kind. Operations upon the anus have also shown a tendency in this direction. Operations that would be attended by great pain without an anæsthetic seem to show the greatest tendency to produce cardiac failure.

The part played by reflex action in the production of syncope has not as yet received much attention. Laborde, some years ago (1890), observed that the heart of the monkey was immediately arrested by the irritative action of chloroform-vapor on the nasal distribution of the trigeminus, and observed that the application of a solution of cocaine to the nasal mucous surfaces prevented the untoward result. Recently Rosenberg, Guttmann, and others have utilized this prophylactic measure during surgical anæsthesia, and have lauded its merits.

Application to nasal mucous membrane, before commencing administration of anæsthetic, of a 10-per-cent. solution of cocaine, repeated every half-hour during long operations and at the end of each operation, to avoid chloroform reflex. Rosenberg (Berliner klin. Woch., Jan. 9, '95).

By the use of cocaine in the manner described the stage of excitement avoided in six personal cases. Guttmann (Med. Press and Circular, Jan. 20, '95).

The advantages of the Rosenberg method are due to drop method of administering the chloroform employed by him. Dührssen (La Semaine Méd., Jan. 15, '95).

Cocaine thus applied especially is advantageous for the removal of adenoid vegetations and tonsils, sleep being much more quiet. Robertson (Brit. Med. Jour., Jan., '95).

Death from arrest of heart might be prevented, in chloroform anæsthesia, by having patient inhale chloroform only by the mouth. In arrest of heart the cardiac muscular fibres cease to contract under the influence of the nasal-nerve reflex through the pneumogastric. Guérin (La Semaine Méd., Oct. 10, '94).

Raul has traced chloroform deaths to reflex paralysis of the tongue and neighboring parts, while Vallas considers primary syncope, due to laryngeal reflex, as one of the usual modes of death when chloroform is employed.

We have, in the production of asthma through intranasal pressure, distinct collateral evidence of the nervous relationship existing between the upper and

lower respiratory tract, and, in the recurrent branch of the pneumogastric, an evident indirect association between the larynx and the heart, to say nothing of the sympathetic system, which plays the most important rôle in all reflex manifestations.

Symptoms of Collapse.—According to Guthrie, the symptoms are alike in all cases, and are as follow: Sudden and complete blanching of the face takes place, leaving it of a ghastly-gray hue. The term "pallor" conveys no idea of the actual appearance. The eyelids fall open, the eyeballs are fixed in the upward position, with pupils fully dilated as under extreme atropinism. At the same time the cornea becomes glazed and sticky, giving an appearance which, once seen, is never forgotten. It can only be described in a somewhat fanciful manner by saying that the light seems to fade from the eye as does the color from the cheek and lips. Probably it is due to flaccidity of the cornea from decrease of intra-ocular tension, noticed by Dubois (Soc. de Biologie, '84). It is the undoubted look of death.

The appearance of a person in a dead faint, or just after a severe accident, is no more than the shade of that which obtains in cases of chloroform collapse.

The pulse and cardiac impulse are at these times no longer to be felt. Respiration commonly ceases at the moment when the blanching and stoppage of the pulse occur, but at times a few feeble and irregular inspiratory gasps are subsequently drawn. The patient is, to all appearances, dead. Whether the heart actually ceases to beat at such times will probably never be ascertained, for the moments are too valuable to be spent in delicate investigations on this point. Neither is it possible to affirm from clinical observation that the heart becomes dilated, as in the experiments of MacWilliam and Johnson on animals. Time cannot be wasted in mapping out the area of the heart's dullness in a patient who is in imminent danger of death.

In some cases lividity, accompanied by turgescence of the veins of neck and face, immediately precedes the blanching and look of death, and is coincident with the stoppage of respiration. Possibly dilatation of the heart has actually taken place, and the condition is that of the true cardiac syncope described by Snow.

It might be objected that, were dilatation present, the cyanosis should continue, and not give place to pallor; but, possibly, as the heart fails regurgitation takes place into the inferior cava, and allows the blood from the distended veins of neck and head to enter the right heart.

In children, cyanosis, except where actual mechanical asphyxia has been produced, is less apparent than pallor. Under treatment, children almost invariably recover from these alarming conditions, whereas in adults the reverse is unfortunately the case.

As a rule, the preliminary signs of collapse are sufficiently well marked, and if observed in time many a catastrophe may be averted.

These signs are circulatory and respiratory.

The circulatory sign is the presence of increasing pallor, not amounting to absolute blanching.

Failure of respiration is marked by a peculiar type of breathing, in which expiration is extremely short and inefficient, while inspiration is sudden, forcible, and gasping, often accompanied by falling of the lower jaw, and spasmodic clonic contraction of the chin-depressers and muscles of the neck. The inspiratory gasps

are irregular and broken, and occur with increasing slowness until the condition of sudden collapse ensues.

This type of breathing is precisely similar to that which is often seen in a patient dying of respiratory failure from other causes.

Under the influence of chloroform the pupil first dilates and then contracts. The dilatation of the pupil of incomplete chloroform narcosis is due, according to Arthur Ward, to mental, sensory, or sympathetic impulses affecting the semi-narcotized cerebrum, and so giving rise to reflex inhibition of the centre of the third nerve. The activity is, therefore, due to the fact that the centre itself is not narcotized. In complete narcosis the contracted pupil is due to the complete subjection of the cerebrum, while the unopposed third-nerve centre remains active, all cerebral reflexes being now barred. *In dangerous narcosis the third-nerve centre itself becoming poisoned, its action no longer controls the pupil, which dilates and grows less and less sensitive to light, while the globe becomes fixed.* This fixation of the eyeball, together with the stertor of breathing and the sluggish pupils, forms the contrast between the danger-stage of chloroform sleep and the second stage, when dilatation of the pupil is associated with shallow breathing, efforts at vomiting, pupils reacting to light, and return of conjunctival and other reflexes. The period of going under is, Ward thinks, the one of most danger. The patient then, by holding his breath, debilitates the respiratory centre by cutting off its oxygen-supply, and so predisposes it to injury by any access of strength of the chloroform-vapor.

Any material dilatation of the pupils means either that the patient is coming around—pupil active and other reflexes will follow—or that the patient is getting too far under,—stertorous breathing, sluggish pupil, fixed eyeballs. In first case more chloroform; in second, drug to be withheld till contraction recurs. A. H. Ward (Cleveland Med. Gaz., Sept., '95).

The degree of narcotism present may, to a great degree, be determined by pupils. Breathing, pupil, and pulse must be watched. White (Brit. Med. Jour., Apr. 20, '95).

When breathing assumes automatic character, indicating that patient is unconscious, the amount of chloroform should be regulated by the size of the pupil; pin-point pupil is the safest sign; large pupil may mean narcosis. R. Gill (Jour. Amer. Med. Assoc., June 8, '95).

Methods of Resuscitation. — When there are indications of syncope, no time should be lost in ascertaining the degree of danger present and the most active means, *artificial respiration* by Sylvester's method *or inversion*, while an assistant is giving hypodermic injection of $^1/_{30}$ grain of strychnine, should at once be resorted to.

Whether artificial respiration will or will not succeed depends, according to B. W. Richardson, upon several circumstances: (1) the time which has elapsed since apparent cessation of vital action in the lower animals, even after seven minutes' restoration has occurred; (2) a high temperature, which favors clotting in the pulmonary circulation; (3) extreme cold; (4) rough movement; (5) inexpert artificial respiration may give the *coup de grâce* to the enfeebled heart.

The defects usually witnessed consist in too-rapid motions, and incomplete emptying of the lungs, so as to induce rapid elimination of the chloroform.

Case of death in a woman in which it was impossible to induce artificial respiration on account of rigid thorax and adherent abdominal viscera. J. G. Clark (Johns Hopkins Hosp. Bull., May, June, '95).

Murray-Aynsley lays stress upon the fact that artificial respiration should not be begun by an act of inspiration; that is, by dragging the arms above the head, for such a proceeding serves to promote further absorption into the blood of the chloroform from the saturated air in the lungs. They should first be brought down close to the body; the thorax is then compressed and the arms are only elevated when the chloroform-laden air is as much as possible forced out. Care should be taken to clear thoroughly the mouth and throat of saliva, mucus, vomited matter, blood, etc., that may be present.

Wood considers "forced respiration" the most valuable plan. He employs a pair of bellows which are connected with a tracheal tube by India-rubber tubing; a face-mask is also required.

> Cases in which, all the usual resuscitative measures having failed, complete inversion and suspension by the bent knees over the operator's shoulders resulted in recovery. Prince (Ther. Gaz., Jan., '93).

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> Rapid and violent artificial respiration and overvigorous efforts in the direction of inversion, etc., may, if the heart is already deeply chloroformed, lead to a fatal distension of that organ. Leonard Hill and Barnard (Brit. Med. Jour., Nov. 20, '97).

Complete inversion—*i.e.*, suspending the patient by the feet or bent knees—is sometimes rapidly effective. Dudley Buxton regards Nélaton's inversion method as the best procedure in cardiac failure when no pulmonary or venous engorgement. In his opinion, artificial respiration stands *facile princeps* for cases of failure of respiration when due to narcotism of medullary centres.

Kelley recommends the following plan, which combines inversion and artificial respiration in an especially-effective manner: "On the first indication of failing respiration the administration of the anæsthetic should be instantly suspended and the wound protected by a fold of gauze. An assistant steps upon the table and takes one of the patient's knees under each arm and thus raises the body from the table until it rests upon the shoulders. The anæsthetizer in the meanwhile has brought the head to the edge of the table, where it hangs extended and slightly inclined forward. The patient's clothing is pulled down under the armpits, completely baring the abdomen and chest. The operator, standing at the head, institutes respiratory movements as follows: Inspiration, by placing the open hands on each side of the chest posteriorly over the lower ribs, and drawing the chest well forward and outward, holding it thus for about two seconds; expiration, reversing the movement by replacing the hands on the front of the chest over the lower ribs and pushing backward and inward, at the same time compressing the chest. The success of the manœuvre should be demonstrated by the audible rush of the air in and out of the chest."

The following plan of resuscitation was pursued by Maas, and, after over an hour, in each case successfully: The mouth was opened, the tongue drawn forward, and the epiglottis raised. The præcordial region was then compressed thirty or forty times a minute (the frequency of respiration). Whenever this was stopped, syncopal symptoms again appeared. Subsequently tracheotomy was performed, as it was difficult to keep the air-passages free; but this did not assist the circulation. The respirations becoming almost imperceptible, Sylvester's method of artificial respiration was

adopted, and more vigorous pressure made over the breast. A similar course was adopted in the second case. The manœuvre is thus performed: The operator stands upon the left side of the patient, and presses, with quick, strong movements, deep down in the region of the heart with the fingers of the right hand, while the ball of the thumb is placed above the left clavicle. The number of compressions is one hundred and twenty or more per minute. The left hand should seize the patient upon the right side of the thorax.

Case in a child, apparently dead, in which the König-Maas method—rapid compression (about 120 per minute) of the præcordium—followed by ultimate recovery. Seven minutes had elapsed during which neither heart-beat nor respiratory effort could be detected. Leedham Green (Birmingham Med. Rev., Feb., '95).

For cases of cardiac failure the heart-muscle should be grasped and compressed intermittently by pushing the hand backward beneath the xyphoid cartilage. Hiffe (Brit. Med. Jour., Feb. 6, '92).

Strychnine.—The value of strychnine as an antidote to chloroform, when given hypodermically, is insisted upon by many, and the experience of the past few years seems to corroborate this opinion. Its main object is to sustain vitality until sufficient elimination of the anæsthetic has taken place. It must be used energetically and administered hypodermically.

[Strychnine hypodermically of greater value when given before the anæsthetic than later. For heart-failure and cessation of respiration very large doses requisite. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

Literature of '96 and '97.

Experiments in which tracheotomy was practiced on dogs, and a tube was introduced into the larynx and put in communication with a small bottle which contained chloroform. Before chloroformization the pressure was noted; then the air, charged with chloroform, was injected, and, when the pressure fell to 0, pure air was injected and an intravenous injection of from 2 to 3 milligrammes of strychnine was administered. When the pressure finally became normal the animal again received inhalations of chloroform. The results showed that, owing to these injections, dogs, which usually tolerated chloroform badly, could support the drug without inconvenience for a greater length of time. The favorable action of strychnine on chloroformization was thus demonstrated. Evenhoff (Union Méd., July 14, '97).

Case of chloroform poisoning in which nearly ½ grain of strychnine was injected; recovery. The tabloids of strychnine were used, strength of $^1/_{50}$ grain each; of these 22 were used, making the total just under the half-grain.

The great value of strychnine as a stimulant to the respiratory centre during chloroform poisoning in keeping life going while the vapor is being exhaled; but the drug must be used boldly.

The use of the electrical current in acting upon the respiratory centres at once, and by increasing the current rapidly, keeps the respiratory mechanism during the dormant stage of strychnine after injection.

With these two agents to hand one ought to be able to treat any case of chloroform poisoning. S. T. Reid (Brit. Med. Jour., Nov. 20, '97).

Electricity. — According to H. C. Wood, attempts to excite contraction of the diaphragm by electric stimulation of the phrenic nerve are fraught with danger, the overflow of the current being likely to lead to cardiac inhibition. Rockwell, however, has reached the conclusion that the inhibiting fibres going to the heart are less affected by electricity than the accelerator nerves. The beneficial effects of the faradic current are due, not to any action it has on the

heart's rhythm, but to its stimulating influence over respiration.

The strength of the current employed to produce this effect on respiration is much less than need be if a cardiac stimulation is aimed at, and the application of one pole over the pit of the stomach and the other under the angle of the lower maxillary near the anterior border of the sterno-mastoid is often fraught with excellent results.

Cold.—The failure of respiration under an anæsthetic may sometimes be overcome and spontaneous respirations initiated by pouring a quantity of ether upon the bared abdomen. The cold thus produced will, says Hare, often prove successful in restarting breathing.

The well-known measure of slapping the surface with wet towels is generally utilized, but does not represent an effective procedure in serious cases.

Nitrite of Amyl.—Great reliance is placed, by W. M. Killen, on immediate use of nitrite of amyl, combined with artificial respiration. Marsh states that it is at the initial stage of heart-failure that it is invaluable. Dudley Buxton argues that whatever value nitrite of amyl may possess, it does not, he thinks, act as an antidote to chloroform. He has found it most serviceable in failure of the circulation from prolonged severe operations, in collapse, and fear-syncope.

Injections of Salt Solution.—The injection, either intravenous or hypodermically, of the physiological solution (6 per cent.) of sodium chloride has been advocated in chloroform toxæmia. The quantity to be injected depends upon the amount of blood lost during the operation.

For chloroform toxæmia the injection either intravenous or hypodermically of the physiological solution of sodium chloride is very highly recommended. Bobroff (Lancet, Jan. 9, '92).

Infusion of salt solution in heart-failure advocated. Reim (Centralb. f. Chir., Nos. 17, 19, '95).

Venesection.—This is an old measure which, nevertheless, has merit. The essential point seems to be that the veins to be opened should be as large and near to the heart as possible, in order that the issuing stream of blood should be of considerable volume and the relief to the heart as rapid and thorough as possible.

Literature of '96 and '97.

Case of arrest of the heart's action and of respiration during chloroform anæsthesia in which the internal jugular vein was opened; compression of the lower chest to relieve the distended right ventricle then resorted to. Several ounces of blood rapidly escaped, and, after the jugular had been clamped by two forceps, artificial respiration was resumed. In less than half a minute the patient made a faint inspiration, followed in a few seconds by another, and, artificial respiration being continued energetically, the heart was heard to beat, at first slowly; but soon the pulse and respirations gained in strength and frequency. The operation was now completed without further administration of an anæsthetic. This case is deemed of importance, as demonstrating that the bleeding from the internal jugular vein, by relieving the distension of the right heart, was the main factor in bringing about the recovery of the patient from an apparently hopeless condition. H. F. Waterhouse (Brit. Med. Jour., July 18, '96).

Rhythmical Traction of the Tongue.—Laborde's method has been successfully employed in a number of cases. Labbé employed it in a case in which flagellation, artificial respiration, and galvanism had been tried in vain. Verneuil extols the method, especially when alternated with flagellations of the epigastrium with a wet cloth.

After-effects. — Headache, nausea, vomiting, bronchial irritation, and hys-

terical symptoms frequently present themselves after the use of anæsthetics, but less so after chloroform than after ether.

When gastric symptoms—nausea, vomiting, etc.—prevail, milk and lime-water frequently succeeds in allaying them. If they are stubborn, lavage with a lukewarm solution of bicarbonate of soda will usually master them. An hypodermic injection of morphine, $^1/_4$ grain, with $^1/_{120}$ grain of atropine, may be used with confidence when the means previously indicated fail.

It is a commonly-observed fact that vomiting after anæsthetization is associated with a severe degree of circulatory depression and not infrequently with actual syncope. Editorial (Lancet, Nov. 10, '94).

[Several cases in the year's literature vividly sustain this point. Ed., Annual, '96.]

The value of inhalations of vinegar to control nausea and vomiting after chloroform is frequently extolled. According to Lewin, the free chlorine—one of the products of chloroform and which is a marked irritant to the pharyngeal mucous membrane and induces vomiting—is neutralized by the acetic acid.

Literature of '96-'97-'98.

Of 174 cases of vomiting following the administration of chloroform, 125 patients were relieved by causing them to inhale the fumes of vinegar previously placed upon a towel and left over the face of the patient for a number of hours, after the chloroform-mask had been removed. If the vomiting returns after this treatment is stopped a renewal of it will be sufficient to check the relapse. Lewin (La Méd. Mod.; Ther. Gaz., Mar. 15, '98).

Paralysis sometimes ensues. It is usually due to pressure against the edge of the table or to strained position of the members. Strychnine and electricity are indicated in such cases, with massage calculated to increase the activity of the local circulation.

Struggles of patients during period of excitation appear to be of considerable importance and capable of directly causing disturbance of cerebral circulation. Cases in which mortal apoplectic area in brain was thus produced. Gross (La Méd. Mod., Aug. 31, '95).

Case of hysterical woman; muscular atrophy of muscles of thumb and interosseous muscle due to bad position of arm during chloroformization. Placzek (La Méd. Mod., Mar. 27, '95).

Case which presented complete paralysis of right arm; still present three months after anæsthetization. Post-chloroformic paralyses generally due to compression of the brachial plexus. Franke (La Tribune Méd., July 17, '95).

Case of musculo-spiral paralysis from pressure. Patient's arm pressed against an iron bar. Several similar cases have been reported. Commonest in laparotomies where operator stands at the side and the arm pulled up to be out of his way. Bruns (Archives Clin. de Bordeaux, Nov., '95).

Literature of '96 and '97.

Paralysis arises from several causes: First, from the position in which the patient is lying, whereby pressure is exercised upon a supplying nerve, or as a result of tractions on the arm or leg of a violent nature. Second, the employment of impure chloroform, which seems capable of poisoning the nervous system and producing such paralysis, at the same time developing transient or permanent albuminuria. Tasse (La Semaine Méd., Mar. 10, '97).

Therapeutics.—The therapeutic uses of chloroform are somewhat restricted. It is an invaluable agent, however, in the treatment of general convulsions of any kind and of whatever origin: eclampsia, epilepsy, etc. As a smaller quantity than is necessary for surgical purposes suffices, the inhalations are not attended with after-effects.

Literature of '96 and '97.

An eclamptic attack, it matters not whether it be a manifestation of genuine epilepsy or not, is an evidence of the diminution in the potentiality of those structures one function of which is to subserve motivity, and a perversion of the dynamics of these parts. It behooves us to cut short attacks of this kind. The best way to do this is by the inhalation of chloroform, not necessarily up to the point of complete chloroformization, but enough should be given to control the severity of the spasms. After that is the time to give bromides, chloral, etc. Editorial (Pediatrics, Dec. 15, '96).

WHOOPING-COUGH.—In whooping-cough inhalations of chloroform sometimes act in a remarkable manner as a calmative. Violent attacks of cough may usually be stopped by pouring a few drops on the hand and holding the latter a few inches under the child's nose. It is also credited with value in chorea, but the almost continuous abnormal movements in this disease render its use inadvisable.

PARTURITION.—The suffering of labor may also be greatly mitigated without danger by a small quantity of chloroform inhaled from a cone just prior to the oncoming pains. The labor is not retarded and the success of the case is not compromised. The aim should not be to produce unconsciousness, but to blunt the sensibility; given in sufficient dose to produce surgical anæsthesia, the general relaxation of the uterine tissues produced tends to increase the dangers of hæmorrhage. Bedford Brown, however, states that the alterations in the vasomotor system of the pregnant woman enable her to resist the toxic action of chloroform to a greater extent than usual.

RENAL AND BILIARY COLIC.—In renal and biliary colic inhalations of chloroform offer the best source of relief when the suffering is beyond the influence of safe doses of morphine. It is superior to ether in that a much smaller dose is required to relieve the pain, while the after-effects are comparatively *nil.*

A. C. E. Mixture.

A. C. E. mixture is an anæsthetic proposed by Harley (as modified by Martindale), and composed of alcohol, as a menstruum, 1 part; chloroform, 2 parts; and ether, 3 parts; by bulk. It is termed the "A. C. E. mixture" from the initial letters of the names of its ingredients. It is thought to present many advantages over ether or chloroform, being less dangerous than chloroform alone and more speedy in its action than ether.

Administration.—The A. C. E. mixture does not seem to possess the advantages claimed for it in text-books. While entailing the dangers of chloroform anæsthesia, it tends to cause confusion in the recognition of the danger-signals.

The fact, recently recognized, that chloroform is not as safe an anæsthetic for children as was generally thought to be the case, has caused the A. C. E. mixture to be tried as a substitute, but only for the first stage, ether being then substituted.

Literature of '96 and '97.

Even in very small children it is far safer to commence the induction with the A. C. E. mixture and substitute pure ether as soon as that drug can be borne. Commencing with A. C. E. on an open or Skinner inhaler, the A. C. E. is then given in a celluloid mask of Rendle's pattern, gradually adding more and more ether; when a fair quantity of the latter is borne, without hesitation the sponge exchanged for one containing ether alone.

The following advantages claimed: (1) the time required to produce good anæsthesia is rarely more than four minutes, (2) the guides to the anæsthetist are

clear, (3) flaccidity and freedom from movement during the operation are complete, (4) the after-effects bear comparison with those after any other method, and (5) the method is safe. Even should an inexperienced administrator encounter stoppage of respiration from an overdose,—the only accident to be reckoned with,—all that is needed is a little compression of the chest, the circulation not being prejudicially affected as in the case of such an event under chloroform. The method is recommended especially for children under five or six years, and for any child with obstruction in the upper air-channels. In children above that age the combination of gas and ether is so well borne that nothing need replace it. G. Rowell (Brit. Med. Jour., May 8, '97).

Physiological Action.—Truman has shown that the depressing action of the chloroform upon the heart by the stimulating action of the ether is not based upon chemical facts, the latter vaporizing out of all proportion to the chloroform. In administering the mixed anæsthetics, therefore, a vapor of varying and uncertain composition is employed.

Examination of the residue left in a Clover apparatus after three administrations of the A. C. E. mixture of Harley. The specific gravities were 1.144, 1.095, and 1.028, giving the respective quantities of ether to chloroform by weight as 45.3 to 54.7, as 51.7 to 49.3, and as 59.5 to 40.5; or by volume as 90.6 to 54.7, as 103.4 to 49.34, and as 119 to 40; that is, to 100 volumes of ether, 50, 47.6, and 3 volumes of chloroform, respectively, in the state of vapor. The residue first examined, as stated above, contained 100 volumes of ether to 75 of chloroform. E. B. Truman (London Lancet, Feb. 16, '95).

The disproportion indicated by Truman is desirable; the most dangerous period is the beginning, and this corresponds with that of excess of ether. Marshall (London Lancet, Feb. 16, '95).

[Ellis, in 1866, experimentally showed that of this mixture ether came off almost pure during the first minute. Chloroform predominated during the next three minutes and alcohol. It was therefore suggested that the vapors, having been evolved, should be administered in the required proportion. The method is cumbersome, however. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

Untoward Effects.—The deaths occurring after the administration of the A. C. E. mixture seem to be associated with pathological conditions similar to those met with in fatal cases following the use of chloroform.

Death of a large, anæmic woman, aged 44 years, after 6 drachms of the A. C. E. mixture had been administered. The same patient had taken ether ten days before. Anonymous (N. Y. Med. Jour., Nov. 17, '94).

Death of a large man of alcoholic habits, after violent struggling. Right ventricle very dilated and cardiac wall fatty; the left ventricle also dilated and fibrosis of the wall. The anæsthetic had not been given more than five minutes. Anonymous (Brit. Med. Jour., Feb. 2, '95).

Literature of '96 and '97.

Death from A. C. E. mixture in an alcoholic subject in whom three previous administrations of the anæsthetic had produced no unpleasant symptoms excepting slight prolongation of the struggling stage. The physical examination showed no lesion of the heart; the urine contained no casts, albumin, or sugar. After a few whiffs and before consciousness was entirely lost, the patient struggled violently and ceased breathing. The pulse continued to beat for nearly a minute after respiration had ceased. No post-mortem permitted. H. S. Jewett (N. Y. Med. Record, Nov. 13, '97).

CHAS. E. DE M. SAJOUS,
Philadelphia.

CHLOROMA. See LEUKÆMIA.

CHLOROSIS. — From Gr., χλωρός: greenish yellow.

Definition.—An affection of the blood

characterized mainly by a reduction of the percentage of hæmoglobin and a greenish hue of the skin.

By a slight stretch of the imagination the skin of a person of dark complexion suffering from chlorosis might be called greenish yellow; but chlorosis is very common in Sweden, where the inhabitants are, as a rule, of a very fair complexion; so that the very name of the disease is, to a certain extent, a misnomer. It has, however, the sanction of ancient usages, and it would be hard to find another to which greater objections could not be raised.

Symptoms.—In investigating the clinical history of a disease which is practically confined to the female sex our first inquiries are naturally directed to the organs of reproduction. We find that chlorosis makes its appearance at or about the time of establishment of menstruation, and the behavior of this function in cases of the disease in question is twofold: It may be either premature or long delayed. Niemeyer states that he has never known the menses to appear between twelve and thirteen years of age in a girl with undeveloped breasts without the supervention of chlorosis. A premature appearance of the menses is, therefore, one of the important events in the clinical history of chlorosis. In such cases, menstruation may appear but once, the discharge being followed by amenorrhœa and chlorosis. In the other class of cases the menses do not appear at the usual time; the breasts and uterus remain undeveloped, while, at the same time, a decided degree of chlorosis makes its appearance. The exact relation between the amenorrhœa and the blood-change is not understood, although it is probable that, in cases of amenorrhœa with a properly-developed genital system, the suppression of menstruation is secondary to the blood-change, whereas in those cases with an undeveloped state of the uterus and its appendages the relation is not so clear. The other symptoms of chlorosis are secondary to the blood-change and include the various manifestations of anæmia in general.

> Analysis of 232 cases, showing that imfect evolution of menstruation, as evidenced by scantiness of the flow and irregularity of the periods, is as regular a feature of chlorosis as the imperfect evolution of the red corpuscles of the blood. These constants were not related to each other as cause and effect, but were independent one of the other. At the same time there is a close relationship between them, whereby the reproduction and development of the red corpuscles of the blood are governed by, or formed part of, the menstrual cycle; and both are influenced by a greater rhythmic action which determined the time and activity of development, growth, and reproduction. W. Stephenson (Brit. Med. Jour., Mar. 16, '89).

It is in this disease that the inorganic cardiac murmurs are so frequently heard, especially over the base of the heart, *i.e.*, over the points of the origin of the aorta and pulmonary artery.

> In 205 cases, 115 had cardiac bruits. Of these, 56 were audible at the base, 13 at the apex, 24 at base and apex, and 22 at base, apex, and back. The last group were always accompanied by distinct dilatation of the ventricle and strong impulse; they were the first to disappear under treatment: a fact which shows that they are present in the more advanced cases. In 2 of the 22 cases the murmur persisted after seven and nine months, respectively. These remain as permanent mitral regurgitations. Barr (Amer. Jour. Med. Sciences, Oct., '91).
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> Many of the bruits supposed to be intracardiac really due to the action of the heart against the lungs. Potain (L'Union Méd., Dec. 23, 30, '90).
>
> The *bruit de diable* and venous hums in chlorosis. The former occurred in 51.4 per cent. of personal cases: a proportion

which is low, inasmuch as the hæmoglobinometer, which detects the disease in the absence of pallor and other visible signs, was used. As to venous hums, none found in 49.4 per cent. of 180 cases; on the right side only in 33.3; on the left side in 6.1, and on both sides in 11.1 per cent. Of 27 cases in which relapses occurred, 66 per cent. have venous hums: a fact which may prove of some use in prognosis. The bruits usually disappeared when the hæmoglobin showed some increase. Richardson (Lancet, June 27, '91).

Venous hums disappear after bleeding cases of chlorosis; hence the cause of these is a plethora, due to hypoplastic blood-vessels. Schubert (Wiener med. Woch., May 2, '91).

The most striking symptom is the sallow hue of the skin and pale, almost white, color of lips and palpebral conjunctiva. This pallid complexion differs from that of the so-called wasting diseases, such as cancer and phthisis, in not being attended with emaciation. In fact, the adipose tissue is not only retained, but persons affected with chlorosis are apt to put on flesh, or, rather, fat. This is explained by the fact that, owing to the greatly reduced amount of hæmoglobin, the processes of oxidation in the body are carried on very feebly.

The other principal symptoms of chlorosis are lassitude and indisposition to exertion, loss of appetite, and other digestive disturbances, and constipation.

The dyspepsia of chlorosis due, as Hayem first pointed out, to lack of hydrochloric acid. Liégeois (Revue Méd. de l'Est, Sept. 15, '91); Labat (Gaz. de Hôp., Dec. 30, '90); Chéron (L'Union Méd., Dec. 9, '90).

Dyspepsia in chlorosis. Seventy cases of chlorosis examined; an excess of pepsin found in 36, a decrease in 28; an excess of hydrochloric acid in 6, and normal gastric juice in 2. In boys and girls at the age of adolescence there is commonly some dyspepsia from "hyperpepsia," and the advent of chlorosis makes this prominent. Hayem (La Sem. Méd., Nov. 4, '91).

Examinations of the gastric juice of chlorotic patients. Conclusions: 1. The amount of HCl in the gastric juice is not diminished in cases of chlorosis; on the contrary, there is a state of hyperacidity in 95 per cent. of the cases. 2. The dyspeptic disorders of chlorosis are neither due to a deficiency of HCl nor to motor insufficiency of the stomach. 3. The indiscriminate employment of hydrochloric acid in cases of chlorosis is to be condemned. 4. The theories which refer either the origin of chlorosis or its chronic character to a state of gastric subacidity are untenable. K. Osswald (Münch. med. Woch., July 3, 10, '94).

Nervous symptoms, such as hyperæsthesia, neuralgia, and hysteria are not uncommon. The urine is pale, of low specific gravity, and deficient in urea. While menstruation is, as a rule, either scanty or suppressed, cases are now and then encountered in which the flow is so profuse as to have given rise to the term "chlorotic menorrhagia." Chlorosis is sometimes attended by febrile symptoms.

Fever may occur in the course of chlorosis. It may be subdivided into three classes: cases with (1) continuous, (2) intermittent, and (3) inverted fever. The continuous form is, perhaps, commonest; the intermittent—of which a remarkable case, with wasting, cough, and other suspicious symptoms, occurred in the practice of Jaccoud—is least so. Paul Chéron (L'Union Méd., Dec. 9, '90).

Cases of pure "febrile chlorosis" very rare, the cases usually so regarded being due to fatigue or other complications. Hayem (L'Union Méd., Dec. 9, '90).

But one case met with; most of them are due to constipation and absorption of poisons from the bowels. Potain (L'Union Méd., Dec. 23, 30, '90).

A febrile type of chlorosis does not exist, but a certain degree of apyrexia accompanies true chlorosis. Hence, when fever is present, it must be attributed to some concomitant morbid state, as constipation or tuberculosis. E. Guam (Il Morgagni, Dec., '94).

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None of the symptoms can be considered pathognomonic. As to the color of the skin, supposed to be due to deficiency of hæmoglobin, the general view is incorrect, as in profound anæmia there is often only the slightest chemical change in the blood, while with no apparent anæmia the change may be profound. There are other coloring matters in the blood of which little is known, and it is to these that the color of the skin is due in chlorosis. Dyspnœa and headache have also been attributed to deficiency of oxygen, consequent on the deficiency of hæmoglobin; but deficiency of hæmoglobin does not necessarily diminish the amount of oxygen present; it has been shown that there may be even more oxygen than normal in such blood. Great stress should be laid on the clear appearance of chlorotic blood; it is to this clearness, due to some anomaly in the blood-pigments, in which hæmoglobin plays little or no part, that the color of the skin is due. Biernacki (Wien. med. Woch., No. 8, '97).

Complications.—There are certain diseases to which chlorosis stands in the relation of a predisposing cause, and which, therefore, may be considered as complications or sequelæ. The chief of these are phthisis, gastric ulcer, chorea, and exophthalmic goitre. There can be no doubt that one of the best prophylactic measures against phthisis is the maintenance of a good condition of the blood, and that, conversely, a poor state of the blood may be regarded as a pretubercular or prebacillary stage of phthisis.

Gastric ulcer is by no means uncommon in chlorotic women, and its occurrence is favored by degenerative changes in the blood-vessels of the stomach, leading to thrombosis and hæmorrhage and subsequent sloughing in the mucous membrane of that organ. Chorea, it is well known, is decidedly more common in females than in males, and, although more frequently observed under than over fifteen years of age, is yet far from being rare between the ages of fifteen and twenty. Its occurrence is undoubtedly favored by chlorosis. The same is true with regard to that peculiar neurosis known as exophthalmic goitre.

Seven cases of chlorosis complicated with the signs and symptoms of exophthalmic goitre, the latter disappearing as the condition of the blood improved and, therefore, presumably symptomatic. F. Chvostek (Centralb. f. klin. Med., Apr. 14, '94).

Cases of chlorosis, complicated by influenza and pleurisy, in which the patient sank into a condition evidently bordering on dissolution. Transfusion of blood performed; the patient at once reacted, and subsequently improved steadily, in the general condition as well as in the quality of the blood. Burton-Fanning and Williams (Lancet, Nov. 28, '91).

When the aortic valves are affected, chlorosis, though a troublesome complication, does not aggravate the malady. Mitral regurgitation, on the other hand, tends to be exaggerated by a chlorotic condition. In these cases iron not only augments the number of red corpuscles, but will lead to a greater capillary resistance, and, consequently, to an improved circulation. Potain (Jour. de Méd., Aug. 14, '95).

Diagnosis.—The diagnosis of chlorosis is made by an examination of the blood and a careful exclusion of organic disease. As stated under the anatomical characters of the disease, the blood-changes are not uniform. There is, however, usually a decided, sometimes a very great, decrease in the percentage of hæmoglobin. In the majority of cases, also, if the disease has lasted several weeks, the blood-corpuscles are diminished in number. For example, in the well-marked case of a young girl, aged 17, whose blood I recently examined, I found the following condition:—

No. r. c. per cubic mm., 2,690,000
Hæmoglobin .....32 per cent.

The percentage of red corpuscles as compared with the healthy standard (5,000,000) was, therefore, 54, so that the value of each corpuscle (the "hæmic unit") was only $^{32}/_{54}$ of the normal, making the real value of the 2,690,000 corpuscles only equal to 1,594,080. Hayem gives 3,520,000 corpuscles per cubic millimetre as the mean of 18 counts, and Coupland about 3,000,000 as the mean of 7 counts. There are conflicting statements with reference to the size and shape of the red corpuscles, and there can be no doubt, as already stated, that they may be normal or subnormal in size.

Bright's disease, which is often very insidious in young people and attendant with great anæmia, is excluded by a careful examination of the urine.

Chlorosis is, as a rule, with few exceptions, a non-febrile disease, and, therefore, if the temperature be elevated, latent tuberculosis should be suspected. A cardiac murmur should not be hastily set down as inorganic, for long-continued anæmia is one of the recognized causes of chronic endocarditis.

The blood diseases from which chlorosis should be differentiated are the following:—

Pernicious Anæmia.—In this affection the skin is more yellow than greenish. Blood-examination shows a relative increase of hæmoglobin and the presence of gigantoblasts; there is also marked oligocythæmia.

Leucocythæmia.—The microscope shows the characteristic increase of white corpuscles, their ratio to the red corpuscles becoming sometimes 1 to 30 instead of 1 to 600, the usual proportion.

Leukæmia.—The facial discoloration is much less marked and the lips are red, instead of pale as in chlorosis.

Hodgkin's Disease.—In this affection the glandular enlargement is more or less marked, and serves to easily differentiate it from chlorosis, in which the lymphatic glands do not play a special rôle in the general dyscrasia.

> Warning against hasty diagnosis of chlorosis from mere inspection. There are various deceptive features, including certain anæsthesias and analgesias, comparable to those of hysteria, but not to be confounded with such. Asthma is a common symptom. The disease has been growing more infrequent, owing to the better hygienic conditions of our time. Potain (L'Union Méd., Dec. 23, 30, '90).

Examination of the fundus frequently elicits a lustreless, dull, and grayish appearance of the optic nerve, when the hæmoglobin is greatly reduced. Inflammation of the optic nerve is occasionally observed.

> Emphasis on the statement that there is in chlorosis a greater tendency to inflammation of the optic nerve and retina than in pernicious anæmia, while the tendency to retinal hæmorrhage is considerably less. The latter fact is notorious, but the former is not so generally recognized. Stephen Mackenzie (Clinical Jour., Jan. 10, '94).

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> A case in a girl, aged 21, in which optic neuritis occurred in the course of chlorosis. Dieballa (Deut. med. Woch., July 9, '96).

> While examination of the fundus often gives indications of anæmia, it does not always do so, especially in cases of anæmia of moderate degree. In chlorosis ocular manifestations are more frequent than was commonly supposed, for, in nearly every case in which the hæmoglobin is markedly reduced, changes in the fundus may be found. The most common change is a dull, lustreless, grayish appearance of the nerve. In per-

Fig. 1.

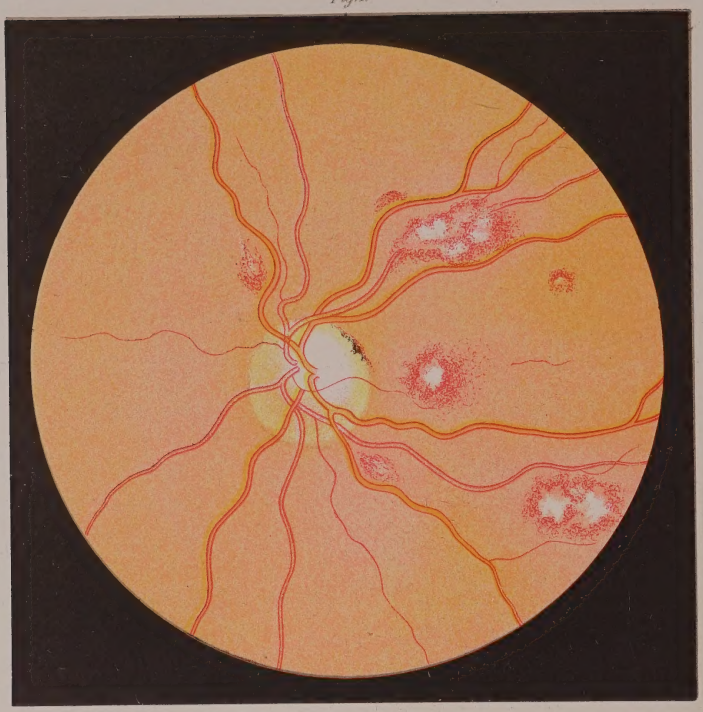
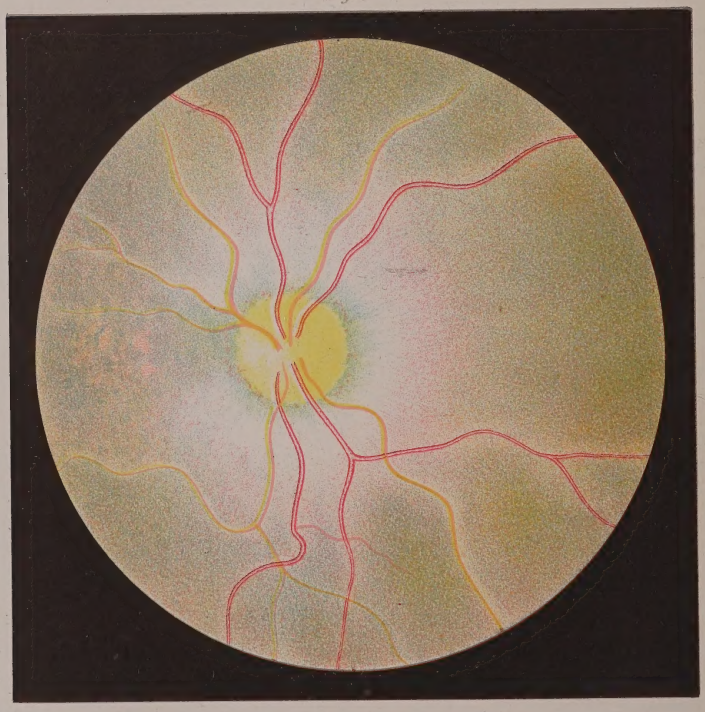


Fig. 2.



Appearance of the Fundus in two cases of Chlorosis. (C. A. Oliver)

TRANSACTIONS OF THE AMERICAN OPHTHALMOLOGICAL SOCIETY OF 1897.

BURK & McKETTRICK, CO. LITH. BALT.

nicious anæmia clinicians have observed retinal hæmorrhages, but they are not so uniformly present as some have supposed. As a rule, they occur in the advanced stage. In initial anæmia from loss of quantity of blood there are seldom ocular changes unless some other factor than loss of blood exists. W. C. Posey (N. Y. Med. Rec., July 10, '97).

Marked case of chlorosis in which the fundus was examined: The surface of the disc was of mottled yellowish white. Its edges were hazy and at places were almost indiscernible. The fibre-layer of the retina, which itself was visible to a more or less degree throughout the fundus, was thickened, opaque, and intensely striated. The underlying choroid, so unlike that which is so common in the negro race, was but sparingly and irregularly pigmented. The retinal veins and arteries, particularly the former, were pallid, with a thickening and pronounced opacification in many places of their lymph-sheath walls. To the nasal side of the disc two faintly-marked lymph-massings could be dimly seen. (*See colored plate, Fig. I.*)

The fields of vision for white and red, especially the former, as shown in sketch 2, were markedly contracted.

Careful testing and retesting of the urine failed to show any course disturbance or evidence of general dyscrasia.

Examination of the blood: The red cells amounted to but 1,608,000, and the white ones were decreased to 3490. The hæmoglobin equaled but 22 per cent. The red cells were quite irregular in size, both microcytes and macrocytes being present. A few nucleated red cells could be seen, but there were some of all types. None of them could be determined to be in the process of cell-division.

Examination of the eyes of a case of chlorosis, while the blood showed that the red corpuscles were as low as 300,000, the whites 2500, and the hæmoglobin reduced to 24 per cent., nucleated red corpuscles being present. The pupils were of the same size. The irides responded equally to light-stimulus. There was a marked tremor of the orbicularis muscle of the right eye. The fields of vision, as well as could be taken, were reduced concentrically. The eye-grounds were about the same on each side. There was a disposition to hæmorrhages into the retina that were characteristic of both the Quincke and the Horner types. The disc was pallid. The retina was somewhat œdematous in the naso-macular region. The larger hæmorrhages, which, as a rule, were deeply seated beneath the fibre-layer of the retina, presented both white and grayish centres, and, as shown in the figure, one enveloped a portion of the lower temporal vein. More careful study made it apparent that a few of the white areas in the hæmorrhages were due to leucocytic aggregation, though the bulk of them were dependent upon tissue-degeneration. (*See colored plate, Fig. II.*) Charles A. Oliver (Trans. Amer. Ophth. Soc., '97).

Etiology.—The chief predisposing causes of chlorosis are to be found in sex, age, and constitution. The forces emanating from these sources come to a focus, so to speak, in a case of chlorosis and that which brings them to a focus in the advent of puberty. The principal of these predisposing causes is, I believe, a congenital tendency to anæmia. Some years ago, while examining the blood of the new-born at the Maternity Hospital, I discovered an infant whose red blood-corpuscles numbered only 3,625,000 per cubic millimetre, the normal average being at least 5,000,000. Now, this child which, by the way, was a female, might, under proper treatment, thrive until the age of puberty, when the demands made upon the blood by the evolution of the sexual system would, in all probability, give rise to well-marked chlorosis. The chief predisposing causes of chlorosis are, I repeat (1) sex, the vast majority of cases occurring in females; (2) age, the decade between fourteen and twenty-four furnishing most of the cases; (3) constitution, either inherited or acquired.

Causes of anæmia in early childhood and the diagnosis of the different forms. Two grand divisions: (*a*) those anæmias with megalosplenia and (*b*) those without. Of the former group are (1) the anæmias consequent upon infantile cholera and other infectious diarrhœas, in which the number of red blood-corpuscles may fall very low, especially when the child had been previously debilitated by tuberculosis, syphilis, or repeated diarrhœa; (2) syphilitic anæmia, entirely comparable to the last; and (3) cancerous anæmia, which observed but once, in a case of a child 2½ years old. Luzet (Revue Men. des Mal. de l'Enfance, May 2, '91).

True chlorosis, when not traceable to external injury or to a primary disease, is a disorder of development, like any other such disorder or sign of physical degeneracy. It is very frequently associated with infantile types of structure in the adult patient, especially ill-developed pelvis, labia, uterus, pudendal hair, and breasts. Stieda (Zeit. f. Gebürtsh. u. Gynäk., B. 32, H. 1, '95).

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Chlorosis is the result, not the cause, of amenorrhœa: a menstrual autointoxication. Immediately before the period the toxicity of the serum is at a maximum. Wet-nurses who menstruate during lactation are apt, during the days preceding the show of blood, to cause their sucklings to suffer from diarrhœa and cutaneous eruptions. Such women themselves often have herpes and fever. Menstruation is a true excretory process: a purging of waste-products. Charrin (Méd. Mod., Jan. 11, '96).

Exciting Causes.—The exciting causes of chlorosis are those of anæmia in general, such as insufficient food, light, air, and exercise; overwork, either physical or mental; anxiety, grief, and nervous excitement in general. There is another exciting cause on which great stress was laid by the late Sir Andrew Clark and which, therefore, deserves to be considered at some length. The cause to which I refer is constipation, and Clark regarded it of such paramount importance that he used the term fæcal anæmia as a synonym of chlorosis. This theory of Clark is based upon certain signs and symptoms that are commonly encountered in chorosis. Chief among them are digestive disturbances. The tongue is generally heavily coated at the base, large, flabby, and with its sides indented with the teeth. The breath is disagreeable and sometimes, according to Clark, has a distinctly fæcal odor. The bowels are either confined or inadequately relieved, and the fæces consist of scybalous masses imbedded in mucus swarming with bacteria. Pain in the side, most marked on the left, is a common symptom, and is believed by Clark to have its seat either in the hepatic or splenic flexure of the colon. This view of the nature of the pain in the side is corroborated by the fact that it may be relieved by large enemata of warm water. According to the authority just named, it is a common thing for young girls to neglect the calls of nature, so far as the bowels are concerned. The fæces accumulate, and, by their decomposition, ptomaines and leucomaines are generated, absorbed, and, by their poisonous action, produce the multiform symptoms of chlorosis. A treatment based upon the theory that chlorosis is due to fæcal retention is sometimes eminently successful, and will be referred to later in detail.

Three cases of chlorosis characterized by the presence in the urine of a peculiar "chromogen"—a colorless substance which becomes converted into a pigment of oxidation. It is manifested by the urine becoming a rose-red color on the addition of nitrous-nitric acid; *i. e.*, pure nitric acid to which a small quantity of the common yellow acid of commerce has been added. Chromogen is a derivative of skatol, and, therefore, derived from fæcal absorption. In all

cases there was marked constipation, the relief of which by large enemata constituted the basis of his treatment. Restoration to health coincided with disappearance of the urinary chromogen. George Herschell (Practitioner, May, '93).

Chlorosis is of intestinal origin. Diminution of urobilin in the urine an important sign. A toxic body found in the urine, "the exact nature of which it has been as yet impossible to determine," but which is believed to be largely accountable for the nervous phenomena of chlorosis. F. Forchheimer (Therap. Gaz., Nov. 15, '93).

Another exciting cause of chlorosis is cold. Prof. Augusto Murri, of Bologna, has published an elaborate paper on the influence of cold in the etiology of chlorosis. He gives the notes of three cases, in which the symptoms of the disease were limited to the cold months of the year, disappearing in summer and recurring at the onset of the succeeding winter, and he states that others precisely similar have come under his observation. He, therefore, styles them "winter chlorosis," or *chlorosis hiemalis*. It is well known that chlorotic patients are often affected unfavorably by such exposure to cold as is well borne by the healthy, and this Murri believes to be due to an instability of the vasomotor system on the part of the former. In fact, he regards chlorosis as a vasomotor neurosis, the blood-changes in the disease being induced by cold, nervous shock, or long-continued irritation from the genital organs or elsewhere.

Meinert, of Dresden, claims to have demonstrated a displacement of the stomach (gastroptosis) in sixty consecutive cases of chlorosis. Fifteen per cent. of the cases were complicated with right movable kidney and in one case both kidneys were movable. The gastroptosis is secondary to enteroptosis and this, in turn, to the pressure of the corset; so that, according to Meinert, it is to this article of female apparel that chlorosis is due. After the cure of a case of chlorosis, its anatomical substratum, the visceral displacement, remains, and hence the notorious tendency of the affection to relapse.

No one doubts the evil effect of tight-lacing, and all will admit that in a person predisposed by inheritance or otherwise to chlorosis the development of the disease may be accelerated by constriction of the thoracic base and consequent displacement of viscera.

Chlorotic subjects often present a high position of the diaphragm. The liver-dullness begins at the upper edge of the fourth or the lower edge of the third rib. The heart-dullness is sometimes found to extend either to the right or to the left. This enlargement of the area of the heart-dullness is probably due in but a few cases to dilatation. Frequently it is of a certainty due to the elevated position of the diaphragm, in consequence of the diminished volume of the lungs. F. Müller (Berl. klin. Woch., Sept. 23, '95).

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In a series of 29 cases dilatation of stomach without retention found in 8 cases; dilatation of stomach with retention found in 6 cases; flatulent dyspepsia in 14 cases. Chlorotic patients are more concerned with the pale color, breathlessness, swelling of the feet, and palpitation than with gastric disturbances. In 17 cases, however, dyspepsia preceded the chlorosis; in 2 cases both appeared simultaneously, and in the remainder the relation could not be determined. Mongour (Archives Clin. de Bordeaux, Nov., '96).

As to Meinert's contention that chlorosis is produced by the gastroptosis brought about by the pressure of the corset: It may be possible to define the outline of the stomach in cases of considerable gastroptosis where the upper curvature lies below the liver and the abdominal walls are lax; but in young

subjects, such as chlorotic girls, the chlorotic walls are not lax. In a large nummer of chlorotics who wore corsets, to map out the lesser curvature of the stomach was found impossible. It is usual, however, in such cases to find the greater curvature extending lower down than usual; this is possibly due to an abnormal distensibility of the stomach: a condition occurring as a result of chlorosis. Leo (Deut. med. Woch., Mar. 19, '96).

There are those who regard chlorosis as an infectious disease. Chief among them is Clément, of the Hôtel-Dieu, Paris, who bases his opinion of its infectious nature on the enlargement of the spleen, which he has found in thirteen cases; on the frequency of fever, the occasional complication of phlegmasia dolens, and the epidemic occurrence of the affection. The hypothesis is well argued, but the facts upon which it is based are questionable.

Blood of chlorotic patients examined for micro-organisms, and in ten or twelve cases either the streptococcus albus or the staphylococcus albus found, the former being the more abundant, and—in rarer instances,—the bacillus coli. Lemoine (Le Progrès Méd., Nov. 17, '94).

Case of double phlegmasia alba dolens in chlorosis in which micrococci were found in the blood; the thrombosis ascribed to the latter. Villard (Marseille-méd., Nov. 15, '92).

Thrombi may form in the cerebral sinuses and cervical veins, though usually they occur in the femoral vein. They necessarily cause death; the two recorded instances of thrombi in the jugular vein ended in recovery. Infection the cause. Bourdillon (Jour. de Méd. et de Chir. Prat., Sept. 10, '92).

Case of chlorosis in which death occurred suddenly from pulmonary embolus. The latter has its origin in a thrombus of the left iliac vein. In this case, as well as the preceding, the diagnosis was based upon the symptoms, there being no account of an examination of the blood. Audry (Lyon Méd., Jan., '93).

Post-mortem appearances in the case of a young woman, 19 years of age, who died of typhoid fever consecutive to chlorosis. The immediate cause of death was thrombosis of the sinuses and veins of the convexity of the brain. Before death œdema of both lower extremities had suddenly developed, and was, in all probability, due to venous thrombosis. It is well established that the condition of the blood in chlorosis is such as to favor coagulation, and this fact should be borne in mind in making a prognosis in the case of chlorotic women who are attacked with typhoid fever or other adynamic affections. Girode (Bull. de la Soc. Anat., Oct., '92).

Enlargement of the spleen observed in twenty-one out of fifty-six cases of chlorosis. Inasmuch as a "fœtal state" of the spleen, marrow, and other hæmatopoietic organs has been described as characteristic of chlorosis, this observation is interesting. F. Chvostek (Allgemeine med. Central-Zeitung, July 22, '92).

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Study of thirty-one cases: Chlorosis is, in the great majority of cases, the result of malnutrition, dependent upon the consumption of an insufficient amount or of an unsuitable quality of proteid; in most cases a great diminution of the nitrogenous excreta of the urine found, while a common symptom of chlorosis is a perversion of the appetite to the excessive consumption of starches and sugars. The superiority of such preparations as ferratin over the inorganic forms of iron suggests that there is value in the proteid material which they contain. Simon (Amer. Jour. of Med. Sciences, Apr., '97).

Prognosis.—The prognosis of uncomplicated chlorosis is invariably good, the response to appropriate treatment being prompt and decided. It should be borne in mind, however, that intercurrent disease of any kind is apt to be unusually severe. This is especially true with reference to febrile disorders, which occasion great and rapid consumption of the blood-corpuscles in healthy

persons. As a matter of course, the powers of resistance to such affections are much reduced in those whose blood is already impoverished. In forming a prognosis the tendency of the disease to relapse should not be forgotten. This is especially marked in those cases in which the development of the vascular and reproductive systems is imperfect; in other words, in those in whom the tendency to anæmia is congenital. Predictions of permanent cure after a single course of treatment should, therefore, be made with great reserve or, better still, should not be made at all.

Pathology.—Virchow endeavored to place chlorosis upon a distinct anatomical basis by the demonstration that, in fatal cases, there is often found an imperfect development of the aorta and arterial system generally. He has found the aorta of a full-grown woman so small as barely to admit the little finger, whereas, normally, it should admit the thumb, and, with this condition of the lumen of the vessel, its coats were found to be much thinner than normal. He regards this condition of the vessels as congenital, and the importance of the observation depends upon the fact that the blood-vessels and the blood-corpuscles are both derived from the same embryonic layer,—the mesoblast,—an imperfect development of the one necessarily entailing the same condition of the other. There is little doubt that Virchow's observation is true with reference to some of the cases, especially those that run a fatal course. A condition of imperfect development of the vascular system might, doubtless, give rise to grave disturbances of nutrition eventually ending in death; but chlorosis is not a fatal disease, the great majority of cases under appropriate treatment terminating in recovery, and with reference to them there is no proof that such a stunted condition of the blood-vessels is present.

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There are anæmias, but there is only one chlorosis. A person is chlorotic; a person becomes anæmic. A chlorotic subject may become anæmic; an anæmic subject does not become chlorotic. We may produce anæmia, but never chlorosis. It is erroneous to look upon congenital stenosis of the arteries as the cause of chlorosis. H. Huchard (Revue de Thér., Mar. 15, '97).

The only constant anatomical changes of chlorosis are those of the blood itself, and it is for this reason that the disease is classed among the primary anæmias. Even the blood-changes are not uniform. The researches of Duncan in 1867 first established the fact that, in well-marked cases of chlorosis, the number of red corpuscles might be normal, while their percentage of hæmoglobin might be greatly reduced, and this anomaly was, for a long time, regarded as the distinguishing mark of chlorosis. It has since been established that this view of the blood-change in chlorosis is altogether too narrow, and at the present day it is generally admitted that the blood-changes in chlorosis may be at least threefold: 1. They may be of normal size and number, their only change being a deficiency of hæmoglobin. 2. They may be diminished in number, with diminished percentage of hæmoglobin. 3. They may be diminshed in size and normal in number and in percentage of hæmoglobin. Of these varieties, the second is the most severe, and in it there are often marked changes (poikilocytosis) in the shape of the red corpuscles, such as are so commonly observed in pernicious anæmia.

From these facts it is evident that there is nothing uniform in the be-

havior of the red corpuscles in the disease called chlorosis; so that an attempt to describe it as a distinct disease from an anatomical stand-point must result in failure. The essential point is that the percentage of hæmoglobin is reduced, but this is common to many forms of anæmia.

> In chlorosis the destruction of hæmoglobin is probably much less than under normal circumstances. This follows from the fact demonstrated by Hoppe-Seyler and A. S. Garrod and confirmed by von Noorden, that the chief product of blood-destruction—hydrobilirubin—is found in the urine and fæces of chlorotics at the utmost in normal quantity; "indeed, as a rule, much less than this." Carl von Noorden (Inter. Med. Mag., Apr., '94).
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> Study of the blood in eight typical cases of chlorosis. Conclusion that nucleated red corpuscles, megaloblasts, and "mark-cells" (myelocytes) cannot be regarded as characteristic of pernicious anæmia, since he has found them in the blood of the above-mentioned cases. Hammerschlag (Med. Press and Circular, July 25, '94).
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> Chlorosis is due to oligochromæmia, the result of faulty hæmopoiesis, in turn due to diminished hæmoglobin production. Hæmoglobin is principally formed in the intestine; this is proved (*a*) by direct investigation upon lower animals, and (*b*) by direct observation upon the human being. Hæmoglobin formation can be increased by the introduction into the intestine of agents not containing iron, but preventing putrefaction. Chlorosis is due to a prevention of hæmoglobin formation by destructive agents acting upon the precursor of hæmoglobin in the intestine. Forchheimer (Boston Med. and Surg. Jour., Aug. 24, '93).

It has been contended by some writers, especially by Immermann, that chlorosis differs from all other forms of anæmia in that the albuminous bodies of the blood-serum are present in that fluid in normal or increased amount. This has certainly been proved to be true in a few cases by chemical examination, but it has not yet been proved that the same may not be true of other forms.

From the above it appears evident that the conditions of the blood and the other organs of the body are so various as to veto the present establishment of chlorosis as a disease with a distinct anatomical basis. With advancing knowledge, some etiological or pathological fact common to all cases of the affection may be discovered, but at present none such is known. With our present knowledge, the most sensible view of the nature of chlorosis appears to me the following, which I have already expressed elsewhere: At the time of puberty there is an urgent physiological demand upon the blood, which is complied with by vigorous persons without detriment to the organism. The ordeal of puberty is safely passed. In less vigorous, but still sound, healthy organisms a decided degree of anæmia, one calling for treatment, declares itself at this time. Finally, in those with any congenital tendency to anæmia, whether this be due to general malnutrition during intra-uterine life or to a special hypoplasia of the vascular system, the anæmia of puberty is intense; the case is a typical one of chlorosis.

Literature of '96 and '97.

> Cases of chlorosis may be divided into three classes: (1) chlorosis with vascular hypoplasia without change in the sexual apparatus; (2) chlorosis with vascular hypoplasia and excessive develment of the genital apparatus; (3) chlorosis with vascular hypoplasia and defective development in the genital apparatus. Even though later researches may show that the vascular hypoplasia is not constant, the lesions of the vessels and the heart will occupy, nevertheless, a prominent place in the pathological anatomy of chlorosis. Gilbert, of Paris (Med. Record, Oct. 2, '97).

Treatment.—As Immermann remarks,

"there is scarcely any point in therapeutics so fully established as the remarkable efficiency of iron in removing all the symptoms of chlorosis"; but it does not follow that iron should initiate the treatment in every case. Nearly all chlorotics are dyspeptic, and until the digestive disorder is relieved the full benefit of iron cannot be obtained. In cases of atonic dyspepsia, the simple bitters, such as quassia or gentian or exciters of the smooth muscular fibres, such as strychnine or brucia, may be administered before meals or, if there is gastric dilatation, naphthol, bismuth salicylate, or chloroform-water may be administered three or four hours after meals, as recommended by le Gendre, in order to arrest the abnormal fermentations usually present in that condition. Lavage is rarely, if ever, necessary. Hyperacidity of the gastric juice should be treated with full doses of alkalies—soda, chalk, lime-water, or magnesia—from one to two hours after meals and anacidity with full doses of dilute hydrochloric acid immediately after eating.

The dyspeptic disorders so often met with may become a serious obstacle to active treatment; such cases should be looked upon and treated as simple dyspepsias, until the stomach be brought into condition for the treatment of the chlorosis itself. Hayem (La Sem. Méd., Nov. 4, '91).

In chlorosis with gastric disturbances the stomach should be washed out at stated intervals. Sixteen cases treated in this way, all with excellent results, and five of the number had been given iron for a month, at least, without effect. The aseptic condition of the stomach may also be attained by administering such drugs as hydrochloric acid, creasote, and betanaphthol, but not so readily as by lavage. Pick (Wiener klin. Woch., Dec. 10, '91).

The first object is to improve the general condition, then exercise in the open air. A. Hoessli (Deut. med. Woch., Sept. 15, '92).

Such mild laxatives as compound licorice-powder and cream of tartar. The preparation of iron used will depend upon individual conditions. Blaud's pill and the tincture of the chloride of iron are preferred. Arsenic ought not to be used alone, but forms a good adjuvant, especially in the form of arsenical waters, like the Roncegno or Levico. Sulphur, so highly lauded by Schultz, acts probably by stimulating the bowels. Nothnagel (Wiener med. Presse, No. 52, '92).

Sulphur bears very intimate relations to cellular protoplasm, and acts in a more important manner in chlorosis than as a mere laxative. It is indicated when iron does not seem to act and when there is not gastro-intestinal irritation. After it has been used for a time, iron may again be administered instead, and with better hope of success than before the sulphur was used. Schultz (Berliner klin. Woch., Mar. 28, '92).

Nearly all chlorotics are dyspeptic, and the mere administration of iron is insufficient. They should get, before meals, the simple bitters, such as quassia or gentian, or exciters of the smooth muscular fibres, such as strychnine or brucia. At the end of the meal, or half an hour after it, the patient is to take a wineglassful of hydrochloric-acid lemonade (3 or 4 parts to 1000). If there is gastric dilatation, naphthol, salicylate of bismuth, and chloroform-water are given three or four hours after the meal, in order to limit or stop the abnormal fermentations generally present in that condition. Hyperacidity is treated with full doses of alkalies from one to two hours after meals. P. le Gendre (Revue de Thér. Medico-Chir., Feb. 15, '94).

Dietetic treatment of chlorosis. This should vary somewhat, according to whether the patient is lean or fat. Lean patients should be given food "copious in quantity and favoring the deposit of adipose tissue." This includes large quantities of butter and such "amylaceous foods as do not irritate the stomach," and about 3 ounces of meat per diem. Unnecessary muscular exertion and exposure to cold should be forbidden, and

in some cases absolute rest may have to be enjoined. The fat chlorotics may be allowed as much as 4 ounces of albumin per diem, and, in addition, no more fat and carbohydrates than will cause the nutritive value of the food to exceed 18 calories per pound of body-weight. Carl von Noorden (Inter. Med. Mag., May, '94).

Milk should be used, or, if this is badly borne, pure water or a hot, weak infusion of tea (hot drinks excite the gastric secretion), eggs, *purée* of vegetables, lean fish, fowl, and cooked fruits. One-half hour before the meal a small dose of an alkali, as sodium bicarbonate, 7¾ grains, should be prescribed for the purpose of exciting the flow of gastric juice. At the same interval after it a Madeira glass of hydrochloric acid in solution in water, 1 to 250. The hydrochloric may be replaced by lactic acid, 1 or 2 grammes (15 or 30 grains) after meals. It is necessary to forbid the use of wines, cinchona-wine, strong beers, alcoholic drinks, and stimulating food. If there are gaseous formations, lavage, either of pure water or water containing salicylic acid, 1 per 1000, is indicated. After two to four weeks of this treatment the use of the preparations of iron can be begun. Henri Huchard (Revue Gén. de Clin. et de Thér. Jour. des Prat., Jan. 19, '95).

Rest in bed, when sufficiently prolonged, is of the greatest importance, checking the too rapid destruction of the red globules. The choice of food is made subordinate on account of the dyspepsia which generally accompanies chlorosis. There is often an hyperpepsia of medium degree and some dilatation. In such cases the food at first should consist of milk and raw meat; later on, of under-done eggs, the easily-digested varieties of fish, *purée* of green vegetables, and stewed fish. No bread is allowed for four or five weeks. In about 20 per cent. of the cases the gastropathic state is more pronounced and needs more care. Sometimes there is intense parenchymatous, gastritis, with marked dilatation; again, there may be a gastritis which has caused diminished glandular secretion and an hypopeptic state. In the former case, in addition to restricted diet, massage is to be used, and lavage also, when abnormal fermentation exists. By the use of these measures it is generally possible to begin ferruginous treatment in from two to four weeks. In hypopeptic conditions, however, iron (either Blaud's pills or the protoxalate) may be used from the first before meals and hydrochloric acid a half-hour after eating. Hayem (Le Bull. Méd., Apr. 21, '95).

According to Dr. Haig, of London, who has done so much to increase our knowledge of lithæmic conditions, "iron cures anæmia by clearing the blood of uric acid." When iron fails to cure chlorosis, he recommends its suspension and the administration of mercurials and salicylates until the blood is cleared of uric acid, after which improvement may occur, without the resumption of iron.

There has been much discussion concerning the *modus operandi* of iron in chlorosis. A study of a few cases, perhaps even of one, will lead the reflecting physician to the conclusion that the cause of chlorosis is not a deficient supply of iron, but something that interferes with its assimilation. Nearly all our food-substances contain iron, and there is probably no drinking-water in which traces of it cannot be found. It is evident, therefore, that there is something that interferes with the assimilation of the iron which is abundantly present in the food of chlorotic persons.

Until quite recently, no satisfactory explanation could be given of the efficacy of iron in chlorosis and especially of the necessity of administering it in large doses, for it was known that very little of the drug was absorbed. Nearly all the iron given by the mouth can be recovered in the fæces, and, therefore, it would appear that a large portion of the drug is wasted and that equally good results might be obtained by its use in small doses. This, however, is not the

case, and, thanks to the investigations of Bunge, we have, at the present time, at least a working-hypothesis on which to base our employment of the metal. In the first place, our food, which contains all the iron we need, does not contain it in inorganic form, but in an exceedingly complex organic combination. Now, in chlorosis, as is so emphatically insisted upon by Sir Andrew Clark, digestive disturbances are exceedingly common. Abnormal fermentations and decompositions take place in the gastro-intestinal tract which give rise to the formation of quantities of sulphides. These decompose the iron contained in the food and completely unfit it for the purposes of nutrition. By administering an inorganic preparation of iron we protect the organic combinations of that metal in the food, for the sulphur in the intestine combines with the iron administered, and allows that normally contained in the food to be absorbed. This theory of Bunge also explains why it is sometimes necessary to administer colossal doses of iron, for, in such cases, the decompositions in the intestine are usually active, sulphur is formed in large quantity and requires a proportionally large amount of iron to take it up.

It is only proper to add that Bunge's theory has lately been contested by Ralph Stockman, of Edinburgh, who claims to have cured cases of chlorosis with sulphite of iron, and who contends that bismuth, manganese, and other drugs which are just as capable of absorbing sulphuretted hydrogen as is iron, are inert in chlorosis. Stockman, nevertheless, acknowledges that the promptest curative effects are obtained with inorganic preparations of iron.

There has been a great deal of discussion concerning the relative merits of organic and inorganic preparations of iron, and there can be little doubt that both are effective. The protoxalate is a favorite preparation of certain eminent French practitioners, while others claim that the best results are obtained with the sulphate, either alone or combined with potassium carbonate, as in the well-known pill of Blaud. For my own part, I am accustomed to place the most reliance on the inorganic salts of iron, although I have obtained good results with both the malate and the lactate. So far as iron is concerned, the efforts of pharmacists seem, of late, to be directed toward the production of preparations which resemble the organic iron compounds of the food. This seems a misdirection of endeavor, for it is just this iron of the food which is not assimilated by chlorotics.

Clinical experience has shown that the chief remedial measure is iron. Treatment with iron ought to be continued eight or ten weeks. No one preparation of iron can be said to be better than another merely as regards iron. The choice of the preparation used should be guided largely by the condition of the stomach. Large doses are probably more efficacious than small doses.

Manganese and arsenic are either useless or unnecessary.

Diet. The most easily absorbed food is the best, but as much flesh should be used as practicable, as it contains more iron than farinaceous food.

Rest in bed is absolutely necessary for the improvement of some cases which are extremely anæmic.

The surroundings of the patient must be improved in order that the patient may remain well. Stockham (Brit. Med. Jour., Dec. 14, '95).

Preparations of iron do not act in the same manner. They may be divided into five groups: (1) the ferrocyanides, which have no action; (2) the blood from an organism of the same species, which may be useful during a certain period; (3) hæmoglobin in solution, which probably penetrates rapidly into the circulation

and is assimilated; (4) the ferruginous salts of vegetable acids, which, at least by subcutaneous injection, are taken up by the circulation, and deposited in the liver; (5) insoluble preparations and ferric-oxide salts, which dissolve in the stomach and later form albuminates and absorbable iron. Blaud's pills and acid lactate of iron have seemed to be the most active in chlorosis. A daily dose of 1 to 1¾ grains is sufficient. For hypodermic injection a 5-per-cent. solution of ferric citrate may be used, a quantity containing from 1 to 1¾ grains being injected daily. Quincke (La Presse Méd., Apr. 10, '95).

Necessity of keeping up treatment until the hæmoglobin has neared the normal; attention called to the value of the hæmoglobinometer in indicating deficiency, even after the patient looks and feels entirely restored. Rochford (N. Y. Med. Jour., July 30, '92).

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The benefit derived from iron in the treatment of chlorosis is self-evident, and cannot be explained away by those who are skeptical about drugs. Iron probably acts as a diffusible chemical compound which counteracts pathological conditions that interfere with the normal regeneration of the blood. Warfvinge, of Stockholm (La Gynécologie, Oct. 15, '97).

Results of treatment by inhalation of oxygen-gas at half the atmospheric pressure in three cases of chlorosis in women, all of whom had previously been treated with iron, and one of them with arsenic as well. In one case there were signs of phthisis. Oxygen inhalations were given three times daily with marked improvement. Iron is not indicated in cases where there is nervous excitement or where digestion is impaired. Such cases do better under arsenic combined with oxygen inhalations diluted with nitrogen. Corish (N. Y. Med. Jour., Feb. 13, '97).

Preference for the liquor ferri sesquichloridi, which, in the German Pharmacopœia, contains 10 per cent. of iron. Administered in 1-drop doses in a wineglassful of water thrice daily after meals, increasing by drops until the patient receives 12 drops daily, it forms a refreshing drink, and improves the appetite. Israel (Ther. Monats., H. 1, S. 21, '97).

In conclusion, I will describe the method of treatment so strongly advocated by Sir Andrew Clark. With careful attention to the diet and a tepid sponge bath, followed by brisk toweling night and morning, he prescribes the following mixture:—

℞ Ferri sulphatis, gr. xxiv.
Magnes. sulphatis, ʒvj.
Acid. sulph. aromat., ʒj.
Tinct. zingib., ʒij.
Infus. gentian comp. vel quassiæ, ʒviij.

M. Sig.: One-sixth part twice daily, about 11 and 6 o'clock.

Occasionally this acid mixture produces sickness, dries the skin, and is otherwise ill borne. In such cases he prescribes the following alkaline mixture:—

℞ Ferri sulphatis, gr. xxiv.
Sodii bicarb., ʒij.
Sodii sulphatis, ʒvj.
Tinct. zingib., ʒij.
Spt. chloroformi, ʒj.
Infus. quassiæ, ʒviij.

M. Sig.: One-sixth part twice daily, at 11 and 6 o'clock. Sometimes neither mixture agrees with the patient, in which he prescribes sulphate of iron in pill with meals and a saline aperient on first waking in the morning. By this plan Clark claims that nine out of ten cases recover in from one to three months, and by careful attention to the bowels, taking twice a week a pill composed of aloes, myrrh, and iron, the recovery will probably be permanent.

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Summary showing the average gain in hæmoglobin per week from the use of

various agents: Betanaphthol, 2 grains three times daily (antisepsis), 30 cases, 1.85 per cent.; Blaud's iron pills, 5 grains three times a day, 31 cases, 5.07 per cent.; cathartics alone, 7 cases, lost 1.50 per cent. Twelve cases treated with Blaud's pills after a course of betanaphthol showed an average weekly increase of 6.70 per cent.; 19 cases treated with Blaud's pills without betanaphthol showed an increase of but 4.50 per cent. Series of 28 cases treated during an average period of 4.3 weeks, with 2 grains of betanaphthol, in tablet form, and 5 grains of Blaud's iron pills three times a day. The average gain in hæmoglobin per week was 7.9 per cent., the maximum gain being 20 per cent. per week for 2 weeks in one case, 14 per cent. for 3 weeks in another, 13 per cent. for 4 weeks in another, while another patient averaged a gain of 11.4 per cent. per week for 5 weeks. The average amount of hæmoglobin possessed by the patients before beginning the treatment was 48 per cent. After 4.3 weeks of treatment it was 82 per cent. Conclusion that the results of combined treatment are considerably better than those obtained with iron alone, and much better than those obtained with betanaphthol alone. Townsend (Boston Med. and Surg. Jour., May 27, '96).

Chlorotic cases can be divided into three classes: Those in which iron is absolutely useless, those in which it is fairly valuable, and those in which it is an absolute necessity. The cases in which it is useless are those which have been deprived of fresh air and sunshine, and only need proper food and out-door life, with stimulant treatment, to regain their health. Those in which it is moderately valuable are the pseudochlorotics, who have as an underlying cause a tendency to develop tuberculosis with general debility; but, as a rule, the more dyspeptic the patient, the less good will iron do. The cases in which the iron is most useful are those in which the patients are devoid of dyspeptic symptoms, when any one of the common iron preparations may be given in large or small doses with advantage. Should there be a syphilitic dyscrasia underlying the anæmia, mercurials should be administered in addition to the iron, preferably the bichloride of mercury. Huchard (Revue de Thér. Medico-Chir.; Ther. Gaz., Sept. 15, '97).

In cases in which there is an acceleration of the heart-beats recourse has been had to medicaments, diminishing the apparent action of the heart, such as digitalis. These therapeutic agents have very little success in such cases, their action being only temporary; so that the palpitations recur; while for some patients digitalis is even hurtful. Dependence should, hence, not be placed upon these agents, but rather upon those acting upon the nervous system, as bromide of sodium, valerian, camphor, etc. (Potain.)

Bone-marrow and ovarian extract have been employed with some success in the treatment of chlorosis, but their value has not, as yet, been sufficiently established to warrant more than an encouragement for further trial.

A case of chlorosis successfully treated by means of bone-marrow. C. Forbes (Brit. Med. Jour., Dec. 8, '94).

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Cases treated with success by administering 4 to 7 grains of Merck's ovarin daily. The ovary influences hæmatopoiesis in two ways: (1) reflexly and (2) by means of an internal secretion.

Ovarian substance tried in several cases. After the first treatment the patients complained of pain in the lower abdomen, discomfort, headache, and muscular pain. Two had fever and rapid pulse. In three patients the result was good. The general health was improved, the anæmia disappeared, the number of blood-corpuscles were increased, and the menses returned. Spillmann and Etienne (Gaz. Méd. de Paris, No. 35, '96).

Marked increase of hæmoglobin and in weight, in four cases of chlorosis treated with ovarian extract during a period of fourteen days. Muret (Rev. Méd. de la Suisse Rom., July 20, '96).

FREDERICK P. HENRY,
Philadelphia.

CHOLELITHIASIS. — From Gr., χολή, bile, and λιθιασις, from λίθος, a stone.

Definition.—The term "cholelithiasis" is applied to that condition which results from the precipitation of cholesterin from bile and from the combination of bilirubin and lime, which form an insoluble compound. These two, cholesterin and bilirubin-calcium, make up nearly the whole mass of the biliary calculi. The calculi are of varying size and density.

The presence of concretions in the biliary passages may produce obstruction of the ducts, ulceration and perforation of the walls, and the formation of fistulous channels. The process may be accompanied by cholangitis, cholecystitis, and perihepatic abscess. Obstructive jaundice, biliary cirrhosis, and intestinal obstruction may be directly caused by gall-stones, and can be discussed under the head of "cholelithiasis."

Physical Properties; Varieties.—Biliary calculi vary in size from that of a grain of sand to that of an English walnut or be even larger.

> Case in which a conglomeration of calculi formed a mass about the size and shape of a pear, which was passed during life. The patient was a female, 60 years of age. Case also mentioned, described by Fiedler, of a stone consisting of three pieces which was over twelve inches in length and weighed forty-six grammes. It completely filled the gall-bladder. Krauss (On "Gall-stones," p. 11).

The smallest (gall-sand) are dark in color and are wholly made up of bilirubin-calcium. Not infrequently a large number of small calculi, angular, facetted, and grayish in color, are found in the gall-bladder or in a sac opening into the common duct.

The larger ones are dark brown or of a dark-yellowish color, depending on the amount of bilirubin-calcium which exists in the outer layer.

When calculi are small they are usually very numerous. In one case over two thousand were removed.

> [Mayo Robson has reported a case in which 728 gall-stones were removed from the gall-bladder and dilated ducts of a woman aged 54. Dr. Peters has witnessed a case (unpublished) in which 563 gall-stones were removed from a distended gall-bladder. J. E. GRAHAM.]

The larger ones exist singly or in small numbers. The shape depends on the number present. When large and single they are round or more frequently oval, but when a number exist together in the gall-bladder or in a sacculated enlargement of the bile-duct they are facetted, the result of attrition. Occasionally a single stone is found facetted: an indication that others have already passed through the ducts.

Classification. — Biliary calculi have been classified according to the proportionate amount of their two principal constituents: cholesterin and bilirubin-calcium. They may be divided into three principal classes:—

1. Pure cholesterin.
2. Mixed cholesterin and bilirubin-calcium.
3. Pure bilirubin-calcium.

The mixed variety is altogether the most frequently met with, and cholesterin is the principal constituent.

Naunyn, whose classification is now generally adopted, makes the following division:—

1. Pure cholesterin.
2. Laminated cholesterin.
3. The common gall-bladder stones.
4. Mixed bilirubin-calcium.
5. Pure bilirubin-calcium.
6. Rarer forms.

The common gall-bladder stones are altogether the most frequent. The

larger ones are about the size of a cherry, and they may be of a lemon or brownish-yellow color. When fractured, the surface presents a crystalline, glistening appearance, in which the light-yellowish color predominates. The cholesterin is arranged in layers between which bilirubin-calcium exists in greater or less quantities. The nucleus is often composed of bilirubin-calcium; broken-down epithelial cells, bacteria, and foreign bodies have been found in the centre. When very numerous, calculi in the gall-bladder are often of a light-grayish color, and consist of an outer shell and a soft nucleus.

The pigmentary, or bilirubin-calcium calculi gall-sand, are small, and are found in greater numbers than the cholesterin and mixed varieties. They are sometimes found in the intrahepatic ducts, and appear to be the result of a catarrhal cholangitis. A rare variety of gall-stones, composed principally of calcium carbonate, is occasionally found.

Besides the constituents already mentioned, the following elements and compounds have occasionally been noted: Calcium sulphate and phosphate; copper and iron combined with bilirubin-calcium. Globules of mercury were found by Ferrictis.

Symptoms.—The symptoms of gall-stones may be studied under three heads: 1. Those produced by the passage of calculi through the natural channels. 2. Those produced by gall-stones when they have found their way outside of the gall-bladder and ducts. 3. Complications and sequelæ.

Passage of Gall-stones Through the Natural Channels.—Gall-stones may remain for years in the gall-bladder without producing any marked symptoms, although bile-pigment may be found in small quantities in the urine. It may, as Dr. Adler has pointed out, pass into the circulation through the base of the ulcer. It is said that the presence of calculi can be made out by palpation and percussion, but sounding for gall-stones through the abdominal walls is now almost universally condemned as being more dangerous than a laparotomy.

Krauss recently described a prodromal state of cholelithiasis. The symptoms, more marked in females, are constipation, flatulency, loss of appetite, and a sense of pressure in the epigastrium. The skin of the face first becomes pale and yellowish, then yellowish brown. The lower portion of the conjunctiva is tinged yellow. The urine is scanty and with excess of uric acid. Bile-pigment, which is at first absent from the urine, afterward appears in small quantities. Bilious headaches and migraine are important symptoms.

When a gall-stone escapes from the gall-bladder, it is usually arrested for a time in the cystic duct on account of its narrowness and of the structure of Heister's valve. In the common duct a calculus may be arrested in any part of its course, most frequently near the duodenal extremity. In the first case biliary colic without jaundice is usually present, and in the latter colic with jaundice. It must, however, be remembered that a calculus may pass through into the duodenum without pain or any other disturbance. This usually happens when the ducts have been widened by the passage of stones previously.

Biliary Colic. — Premonitory symptoms—such as those of dyspepsia, a feeling of weight and distress with great restlessness—may be present. The onset is usually sudden: a severe paroxysmal pain is experienced in the gall-bladder region, radiating upward to the right or

left shoulder, across or down the abdomen to the thighs. The pain is paroxysmal and increases in severity until it reaches a climax. The patient becomes more and more restless, tossing upon the bed or throwing himself from the bed to the floor, rolling about in agony. When the suffering reaches its height, vomiting may occur, which may in turn, be followed by sudden relief. Intervals

The cut edges of the duodenum are stitched together, leaving a portion of the mucous membrane exposed. A gall-stone protrudes partly through the duodenal opening of the common bile-duct. (*Anderson.*)

of comparative ease may follow paroxysms of pain, and this may continue for hours and even days.

[Dr. H. B. Anderson, of Toronto, witnessed the case (unpublished) of a woman, aged 50, who died after six months' illness. Had deep jaundice throughout; also pruritis, with, latterly, chills, fever, and purpura. Suffered no pain. Had previous attacks of cholelithiasis with great pain, but no marked jaundice.

Autopsy showed well-marked catarrhal cholangitis. Gall-bladder thickened, distorted, and atrophied, and contained a small quantity of bile. Common duct greatly dilated, had conical-shaped calculus impacted at and partly protruding through the duodenal opening. (See wood-cut.)

On bacteriological examination, the colon bacillus was found in the blood, spleen, and liver. J. E. GRAHAM.]

The vomiting already mentioned occurs toward the end of the seizure, in a large number of cases. The contents of the stomach are first expelled, and bile follows. In some instances the vomiting may be continuous and persistent, and may itself be a dangerous symptom.

Two cases of persistent vomiting from calculi in the ducts, upon which operation was performed. In one the vomiting continued for days after the cause had been removed. The patient, however, made a good recovery. In the second the emesis had been so persistent that the patient had to be sustained by nutritious enemata for four weeks previous to the operation. Afterward the vomiting continued for two weeks, when death took place from exhaustion. Mayo Robson (Allbutt's "System of Medicine").

The severity of the collapse varies in different cases. It is marked by cold, clammy skin, pallor, and weakness and frequency of the pulse. It has, in some instances, proved fatal. Potain mentions acute dilatation of the right heart as sometimes taking place in biliary colic.

Case of a woman, aged 47 years, who died suddenly in collapse, preceded by agonizing pain, while under treatment for hepatic colic. There was found in the abdomen a blood-clot weighing 600 grammes (20 ounces), and some sanguinolent liquid. Pauly (Lyon Méd., Jan. 24, '92).

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Report of a case from heart-failure during an attack of biliary colic in a diabetic patient. Changes in the myocardium were found at the autopsy. Elsner (Med. News., Feb. 5, '98).

The presence of a tumor below the costal line indicates dilatation of the gall-bladder, which takes place in early attacks. A distended gall-bladder may occasionally exist in more or less chronic biliary lithiasis as a result of impaction of the cystic and common ducts. It is, however, more frequently found in cases of malignant disease. Enlargement of the spleen is present in some febrile cases.

Hepatic colic may also be due to a simple spasm. 1. Clinical proofs: hepatic colic is common in cases of hysteria, where no gall-stone is present. 2. Proofs from pathological anatomy: Cases have been observed of jaundice and colics in which the only lesion found was contraction of the bile-duct. 3. Experimental proofs: spasm of the lower part of the common duct can be set up in dogs. Lépine (Lyon Méd., Feb. 18, '94).

At the commencement of an attack of cholelithiasis—*i.e.*, at a time when pain has not set in—a tumor represented by the gall-bladder is tangible. This disappears directly the gall-stone reaches the intestine. Not infrequently the pains do not at once subside; these may be caused by slight circumscribed local peritonitis in the region of the gall-bladder, and may be lessened by ice-cold compresses. Swelling of the gall-bladder may also be caused, however, by occlusion of the common duct by ascarides, *Distoma hepaticum*, or inflammatory exudations and by a tumor of the head of the pancreas pressing on the gall-duct. Gerhardt (Deut. med. Woch., Oct. 15, '93).

Catarrhal jaundice; cancer of the pancreas, gall-bladder, or ducts; cancer or tuberculosis of the liver, malaria, or cardiac disease may give rise to symptoms simulating those of stone in the common duct. G. W. Webster (Jour. Amer. Med. Assoc., June 22, '95).

Possibility of confusion between a distended gall-bladder and movable kidney. To distinguish between the two conditions it must be remembered that a distended gall-bladder, as well as the kidney, is a frequent cause of movable abdominal tumor. The range of motion in the gall-bladder is, however, always in the arc of a circle, the centre of which is a point beneath the right lobe of the liver. The history of a distinct attack of jaundice is an important factor in diagnosis. A distended gall-bladder can generally be felt, whereas a movable kidney often cannot. The gall-bladder, if distended with stones, is much harder than the kidney. Henry Morris (Brit. Med. Jour., Feb. 2, '95).

In cases of gall-stones in which biliary colic is not present diagnosis is usually not made till the autopsy. Dull pain in the region of the liver and vomiting noted in several cases. The gall-bladder is not usually palpable; it could be felt in one of the cases described, but not in the others. A. L. Benedict (Med. News, June 8, '95).

Krauss, who was himself a sufferer from biliary colic, gives the following chief symptoms:—

1. Sudden onset between two and three hours after a meal.

2. Violent, spasmodic, paroxysmal pains over the hepatic and epigastric region radiating upward over the right half of the thorax.

3. Labored respiration, feeling of distress, nausea, and vomiting.

4. Slow, hard pulse and cold extremities.

5. Sudden or gradual termination of the attack.

6. Onset of jaundice, which under certain circumstances follows the attack.

The amount of pain does not depend so much upon the size of the stone as upon its shape. A small calculus with sharp projections will cause more pain

than a much larger one which is round or oval.

When the stone is arrested in the common bile-duct, similar symptoms to those already described manifest themselves, together with jaundice. It is generally thought that the pain is not so sharp or severe when the calculus lodges in the common bile-duct as when it is arrested in the cystic duct.

Icterus ensues a day or two after the commencement of the attack, and its intensity will depend upon the amount of obstruction. Bile-pigment may be found in the urine before any change is noticed on the skin or conjunctiva. In severe cases the liver may be slightly enlarged and tender and the skin of a dark-yellow color. The urine is dark and the fæces clay-colored. When the obstruction remains, symptoms of a chronic jaundice are observed, accompanied by intense itching of the skin and extravasations. Want of appetite, foul breath, and slow pulse are symptoms often met with.

The jaundice of cholelithiasis is generally more or less intermittent in character, differing, in this respect, from that of cancerous obstruction, which is usually progressive. Jaundice may continue some days after the stone is expelled, when thickening of the wall may still cause obstruction.

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The presence of bile-pigment in the blood does not appear to cause any considerable disturbance of function and in any case is only slightly poisonous. The bile-acids, on the other hand, when they enter the blood act as virulent poisons on the nervous and muscular systems and on the blood-corpuscles, as first shown by Dousche. Thoma ("Path. and Anat.," vol. i, p. 29).

[This statement is not altogether in accord with the views of Bouchard, who regarded the bile-pigment very poisonous, and who ascribed its comparatively mild effect to the fact that it is either absorbed by the tissues or rapidly given off by the kidneys. J. E. GRAHAM.]

Gall-stone attacks are frequently accompanied by fever, and in some instances the temperature may rise to 104° F. In such cases there is usually a rigor, followed by great heat of skin. The sweating stage is often absent. This has been called hepatic-intermittent, and is probably of the same character as that which sometimes follows the passage of instruments through a constricted urethra. The fever is thought to be reflex by some, but it is more probably the result of toxin absorption.

The length of time required for the calculi to find their way through the cystic and common duct varies in different cases. They may pass through so rapidly and easily that obstructive jaundice may not occur. Again, they may remain months in the ducts causing very frequently incomplete obstruction. This is termed by some the irregular form of cholelithiasis.

In some cases the calculus floats in a distended portion of the duct, usually the ampulla of Vater, causing an intermittent or remittent jaundice.

Fenger agrees with Courvoisier that gall-stones in the common duct give rise to a series of special symptoms by which the situation can often be diagnosed with a fair amount of certainty. Some of these symptoms and conditions are:—

1. Atrophy of the gall-bladder and absence of tumor.

2. Presence of icterus, which may be (*a*) intermittent: complete freedom from jaundice when the calculus passes into the duodenum. (*b*) Remittent jaundice is usually caused by a floating gall-stone acting as a ball-valve.

3. Colic. Localization of pain outside of the gall-bladder region indicates stones in the common duct. Remittent pain is the sign of a stone floating in a dilated portion of the duct. This pain is sometimes relieved by change of position.

4. Intermittent or remittent fever.

Literature of '96 and '97.

Histories of a number of cases. In one of these the first attack of colic with icterus had occurred two years before. These attacks then became more and more frequent and were accompanied by slight remittent icterus. There was also remittent pain every two or three days for three weeks, followed by fever, *icterus gravis*, and death. The autopsy revealed one small floating stone in the dilated common duct.

In a second case the first attack of biliary colic had taken place two years previously, followed by icterus. Second attack occurred on October 24th, followed by lighter attacks, loss of weight, slight icterus, but no tumor. Operation of choledochotomy. One stone, two centimetres in diameter, was removed; no leakage; recovery. The patient gained fifty pounds in three months. Fenger (Amer. Jour. Med. Sci., p. 286, '97).

Symptoms of a gall-stone in the ampulla of Vater acting as a ball-valve. Chronic jaundice, rarely deep, varying in intensity, at times almost or entirely disappearing, to deepen invariably after a paroxysm of pain. Often a constant sense of discomfort, which may be agonizing or griping or like an ordinary liver-colic. Fever occurring in paroxysms; chills may be quotidian or tertian in type. The spleen usually enlarges with the febrile paroxysms. Although lasting for months or years, the health may not be much affected, the patient being able to work between the paroxysms. Such cases are often diagnosed as chronic malaria, abscess of the liver, or suppurative cholangitis. Osler (Lancet, May 15, '97).

PASSAGE OF GALL-STONES OUTSIDE THE ORDINARY CHANNELS.—The symptoms will depend upon the course taken by the calculus. In some instances the stone passes through the ulcerated wall, and, owing to the presence of pyogenic organisms, an abscess forms, which gives rise to symptoms similar to those of appendicitis; pain, high temperature, localized tenderness, and swelling. The abscess may open into a neighboring cavity, most frequently at the intestines, or it may extend outwardly. In other cases the stone may form a fistula with very few localized or general symptoms. Large calculi have been passed by patients which from their size must have made their way by ulceration from the gall-bladder into the intestines, although no history could be obtained tending to indicate that such a process had taken place. As a rule, however, there is more or less local pain, tenderness, and swelling.

The broncho-biliary fistula is accompanied by severe coughing and the expectoration of bile. Gall-stones have been expectorated in some cases. I have reported a case in which expectoration of bile was present three weeks and then ceased to return; after ten years' time calculi were found in the common duct.

Sudden death has been witnessed in a case in which rupture took place into the pericardium.

Literature of '96 and '97.

Fatal case of impacted gall-stones with acute hæmorrhagic pancreatitis. Symptoms of severe gall-stone colic in the evening were followed by collapse the next morning; death at 9.30 A.M. At autopsy a large quantity of blood in the abdominal cavity was found to have come from an engorged pancreas. A gall-stone was impacted in the common duct and thirteen were found in the gall-bladder. J. Anderson Smith (Brit. Med. Jour., Aug. 21, '97).

Dilatation of the stomach due to in-

flammatory adhesions, closing the pylorus, or to the presence of a gall-stone making its way through the pylorus is attended by the usual symptoms of such a condition. Calculi have been expelled from the stomach, which have either found their way into that viscus directly, or, as is more commonly the case, have been regurgitated from the duodenum.

[The following case presents some peculiar features: The patient had been under the writer's observation for many years previous to his death. Fifteen years before he suffered from biliary colic and obstructive jaundice. A hard mass remained, which was thought at the time to be cancer. The patient recovered and the tumor disappeared. He was afterward troubled with a peculiar form of diarrhœa: awakening toward morning he had two or three watery passages, which weakened him very much. These attacks toward the close of his life became more frequent and were very distressing. The cause was supposed to be want of tone in the pylorus, which allowed undigested food to pass into the bowel. Very little of the latter, however, was noticed in the discharges. The following condition was found at the autopsy: There were many old inflammatory adhesions in the region of the gall-bladder. The latter was much contracted and dislocated. The common duct was very small.

There was a large secular dilatation of the duodenum, which formed a pouch four inches from the pylorus. The pouch was continuous with the intestine below by a valve-like orifice about the size of the pylorus. This was probably formed in the passage of the gall-stones fifteen years before, and it is probable that the contents of the stomach accumulated in the pouch and were at times discharged, producing the sudden attacks of diarrhœa. I am indebted to Drs. Powell and Anderson for the post-mortem notes. J. E. GRAHAM.] (Case has not been published.)

The arrest of calculi in the intestines produces at once a series of very grave symptoms of gall-stone ileus. The most prominent are sudden and severe pain; nausea; vomiting; rapid, quick pulse; with other symptoms of collapse. The mortality in such cases is very high. The lower part of the jejunum is the usual seat of the obstruction. When the stone is arrested in the duodenum, the gastric symptoms are much more marked, and, when in the lower part of the small intestine, indican may be found in excess in the urine.

Analysis of 105 cases of intestinal obstruction, by gall-stones, with a mortality of 50 per cent. There is rarely a history of jaundice, or biliary colic, and fæcal vomiting is common. The course is sometimes acute, but more often chronic. The stone is most frequently arrested in the small intestine. Kirmisson and Rochard (Archives Gén. de Méd., Feb., '92).

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Fatal case of gall-stone ileus. The patient had for a long time suffered from attacks of pain, especially when tired from standing. At the operation the stone was found, after a long search, in the small intestine and removed. It was olive-shaped and weighed 400 grains. Death from collapse took place two days after the operation. Bridon (Annals of Surg., Jan., '97).

Case in which a tumor existed in the pyloric region fifteen months and was generally thought to be a cancer. It was afterward shown to have been caused by an enormous gall-stone, which ulcerated through into the duodenum and brought on symptoms of intestinal obstruction. A stone (weighing 368 grains, 5½ inches in circumference, and 3 inches long) passed with some difficulty through the rectum. It was composed almost altogether of cholesterin. Eleven months afterward the patient passed another stone weighing 240 grains. Elsner (Med. News, Feb. 5, '98).

Complications and Sequelæ. — The most frequent complication of cholelithiasis is catarrhal inflammation of the

gall-bladder and ducts. In fact this occurs so often in the chronic form of the disease that it is generally regarded as an integral part of it. Thickening of the walls of the ducts may take place to a sufficient extent to produce permanent obstruction and chronic jaundice. Thickening of the walls and contraction of the cavity of the gall-bladder result in atrophy.

Sometimes the process ends in a fibrous perihepatitis, and the calculus will be found imbedded in a dense mass of connective tissue. These attacks are accompanied by more or less pain and tenderness in the hepatic region and by a slight elevation of temperature.

Acute phlegmonous inflammation of the gall-bladder is a rare disease. Courvoisier described it under the term "Acute Progressive Empyema of the Gall-bladder," and collected notes of seven cases. This condition may exist when gall-stones are not present, but it is usually a complication of cholelithiasis. Typhoid and typhus fevers, malaria, and septicæmia are the usual primary diseases. The symptoms are those of a low, adynamic fever, rapid and feeble pulse, great depression, with tenderness and swelling over the right side of the abdomen. As a rule, general peritonitis supervenes and death takes place. Occasionally it terminates in a perihepatic abscess, which may be opened and a cure effected.

Pyogenic organisms may invade the gall-bladder when distended on account of obstruction in the cystic or common duct and give rise to suppurative cholecystitis and cholangitis. The patient experiences pain and tenderness in the hepatic region. A tumor more or less tender may be distinctly palpated. The general symptoms are those of fever, viz.: irregular and high temperature, rapid pulse, and great loss of strength. The symptoms of pyæmia may be present, viz.: rigors, heats, swellings, loss of appetite, nausea, vomiting, and great depression. This fever must be distinguished from Charcot's hepatic intermittent, in which there is no pus present.

Suppurative cholangitis presents the same general symptoms, but no tumor is felt, and the enlargement of the liver is more marked. Great tenderness may exist over the hepatic surface. Persistent jaundice is a constant and marked symptom.

As described by Naunyn, hepatic abscess may arise from cholelithiasis in several different ways:—

1. An empyema of the gall-bladder may burst into the liver.

2. Purulent cholangitis of the intrahepatic ducts leads to ulceration, which may exist in different places in the liver.

3. The hepatitis sequestrans of Schüppel.

4. Metastasis or embolic abscess.

Ulcerative endocarditis may arise from infection entering the circulation through the walls of the gall-bladder or ducts.

> [The following case, an example of this, was seen by the writer, who is indebted to Dr. H. A. Bruce, the attending surgeon, for the notes here given: Mrs. A., aged 45, suffered fifteen years from recurring attacks of biliary colic. During last attack pyæmia developed, which ended fatally. Post-mortem: the bacillus coli communis was found in the heart's blood. Aortic valves were ulcerated and covered with vegetations. Gall-bladder contained six stones and its mucous membrane showed ulceration, through which it was thought the bacilli had gained entrance to the circulation. There was no evidence of cholangitis. J. E. Graham.]

Hæmorrhage is a complication which may occur as a result of the action of biliary toxins on the blood. Gastric and

intestinal hæmorrhage may arise from this cause or from ulceration into the blood-vessels. Intestinal hæmorrhage may also be caused by passive congestion, the result of thrombus of the portal vein due to the pressure of biliary calculi. Naunyn has not observed copious hæmorrhages from this cause.

Perforation of the gastric or intestinal mucous membrane is an occasional cause of hæmorrhage. The writer has observed two cases in which he concluded from the history that hæmorrhage had arisen in this way; but he was not able to verify his conclusions.

In Aufrecht's case, quoted by Naunyn, a large stone had partially broken through from the gall-bladder into the hepatic tissues; this led to severe hæmorrhage, and the blood had entered the gall-bearer and thence had flowed into the intestine along the cystic and common ducts. Ulceration of the portal vein and aneurism of the hepatic artery may also cause fatal hæmorrhage.

Diagnosis.—The diagnosis of the form of biliary colic produced by the arrest of gall-stones in the cystic duct is often difficult. The unbearable, cutting, tearing, paroxysmal pain seated in the gall-bladder region and radiating to the right or left shoulder is an important characteristic. The presence of a tumor in the hepatic region, after an attack, of the characteristic shape of a distended gall-bearer is a confirmatory sign.

Of the conditions from which it is to be differentiated, the most frequent are: neuralgia, pleurisy, gastric colic, intestinal colic, and appendicitis.

Pleurisy.—The presence of pleurisy may be made out by careful physical examination.

Neuralgia.—The painful points of neuralgia should be looked for.

Gastric colic, especially that form in which there is a spasmodic painful contraction of the pylorus, is very difficult of differentiation. When the pains rapidly follow, for instance, the taking of cold water and the symptoms are prominently of a gastric character, the condition may be recognized as one pertaining to the stomach and not to the liver.

Intestinal Colic. — In intestinal colic the seat of pain and the character of the latter differ from those of biliary colic. Chills and fever accompany biliary more frequently than gastric or intestinal colic.

Acute Appendicitis. — The differentiation of acute appendicitis is sometimes very difficult, especially in cases in which adhesions to the under-surface of the liver follow an attack. Difference in the seat of pain in first attack is nearly always marked.

In biliary colic the pain often radiates upward to the shoulder, while in appendicitis it is experienced in the region of the umbilicus.

In the writer's experience, it is of the greatest importance to note down accurately the history of the case and to observe whether the symptoms are hepatic, renal, or intestinal. A careful examination into the clinical history is of almost as much importance as are the physical signs.

The presence of gall-stones in the fæces is the crucial test in the diagnosis. These may escape observation unless great care is taken in the examination. The stools should be made as fluid as possible by the addition of water and passed through a fine sieve. The principal points in the diagnosis of chronic cholelithiasis are the attacks of pain more or less severe in the hepatic region, tenderness of the liver, the presence of a tumor resulting from perihepatic in-

flammation or abscess, exacerbations of fever with or without local pain; jaundice, usually intermittent or remittent; not often persistent and increasing.

The differentiation between a distended gall-bladder and a displaced right kidney is often difficult. It is not infrequently impossible to make a distinction by noting the shape and size of the tumor; occasionally all the methods generally laid down, such as the movements of the gall-bladder by respiration, the limitation of its movements, and the relative situation of the colon, are all of little use. Sometimes by careful palpation the kidney and gall-bladder can be separated and a positive diagnosis made.

If after a careful examination into the history and present condition, especially an analysis of the urine, the symptoms and signs are found to be hepatic rather than renal, the tumor will probably be a distended gall-bladder. As before stated, a displaced kidney attached to the under-surface of the liver may cause jaundice by drawing the common bile-duct out of place.

A distended gall-bladder may require to be differentiated from pyloric and intestinal carcinoma, fæcal impaction in the colon, tumor of the liver and of the right kidney; also from a tongue-like projection of the liver, which is occasionally found.

Study of 64 cases of cholelithiasis, of which 13 were in men and 51 in women. Almost always able, on palpation, to detect swelling of the liver, and not infrequently the distension of the gall-bladder, in conjunction with jaundice. Fürbringer (Deut. med. Woch., Apr. 10, '91).

If the liver has been displaced or its form changed by tight lacing, a distended gall-bladder may be tilted backward toward the spine and may be mistaken for a renal tumor.

A tumor may be present though it cannot be detected either by the eye or by palpation. I have operated upon a woman because of frequent attacks of jaundice, when the gall-bladder was distended to the size of a large pear by a gall-stone and a quantity of bile, yet a tumor was not revealed until the peritoneal cavity was opened and the fingers introduced. Henry Morris (Krauss, on "Gall-stones," p. 93).

Literature of '96-'97-'98.

Special attention to the careful examination of the urine for bile-pigment in obscure cases of cholelithiasis without marked jaundice. Bile-pigment may find its way into the general circulation through an ulcerated surface in the wall of the gall-bladder or ducts, when there is no obstruction. Adler (N. Y. Med. Monats., '97-'98; N. Y. Med. Jour., Feb. 27, '97).

Prognosis.—The presence of calculi in the gall-bladder is not of so much importance when they do not give rise to any pronounced symptoms; but in all cases they are to be looked upon as foreign bodies which may at any time give rise to dangerous symptoms. When phlegmonous inflammation of the gall-bladder takes place, the prognosis is grave.

Biliary colic is not always free from danger. Some cases of death from heart-failure have been recorded. Distended gall-bladder from calculous obstruction of the cystic duct when accompanied by elevation, and irregularity of temperature, with local pain and tenderness, suggests the possibility of suppuration. Cholecystitis may result in rupture of the gall-bladder or in general septicæmia. Both conditions usually terminate fatally.

Hepatic and perihepatic abscesses are of grave import. The prognosis of jaundice depends on the amount of obstruction and the previous health of the

patient. If the jaundice is intermittent or remittent, as is the case when a calculus floats in an enlargement of the common duct, the danger is not great, because the system will eliminate the poison in the interval.

If the patient have a poor constitution or if the kidneys are diseased; a moderate amount of jaundice may prove serious. The grave symptoms of jaundice are a slow pulse, lethargy, and the occurrence of hæmorrhages through the mucous membrane or into the tissues.

Gall-stone operations in jaundiced cases are much more hazardous than those done when that condition is absent.

The prognosis of cholelithiasis is much more favorable since the development of hepatic surgery, and the experience of the last two or three years would seem to indicate that it is possible to remove calculi in the most difficult cases with comparative safety if the patient be not allowed to become too much poisoned by the toxins of bile and by those resulting from membranous infection.

Etiology.—Biliary calculi have been found at all ages, even in newborn children. The fact is well established that cholelithiasis increases in frequency with advancing years. According to Schroeder's statistics as given by Waring, gall-stones were present in the following percentages of cases:—

Under 20 years, 2.4 per cent.

Between 20 and 30 years, 3.2 per cent.

Between 30 and 40 years, 11.5 per cent.

Between 40 and 50 years, 11.1 per cent.

Between 50 and 60 years, 9.9 per cent.

Over 60 years, 25.2 per cent.

Krauss found in actual practice that gall-stones diagnosed by symptoms during life occurred most frequently in men between the 40th and 60th years, and in women between the 30th and 50th years. Recklinghausen's statistics of autopsies made between 1880 and 1887 give the percentage of all stones: 4.4 per cent. of men and in 20.6 per cent. of women.

> In autopsies performed at Munich, gall-stones found present in 5.4 per cent. of the cadavers. The relative frequency of the disease in women, as compared with men, was as 5 to 2. In 111 women with gall-stones 37 had at the same time constricted liver. Collating over 5000 post-mortem examinations, found 2.7 per cent. in those from 15 to 30 years of age, 5.9 per cent. in those from 30 to 60 years, and 15.2 per cent. in those over 60 years of age. In the majority of cases the disease is so latent that it is not discovered during life. Bollinger (Münch. med. Woch., Apr. 28, '91).
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> Only 111 cases (30 men, 81 women) were treated for cholelithiasis during twenty years (1870-1890) in the general hospital at Copenhagen. During these years there were 9172 post-mortems performed (5448 men, 3724 women), and in only 347 (3.78 per cent.) of these were gall-stones found, namely: 127 men (2.34 per cent.) and 220 women (5.9 per cent.); 315 of these did not present any symptoms of gall-stone during life, although in some cases the stones were as large as walnuts. Paulsen (Centralb. f. Chir., Feb. 4, '94).

In women the largest number of cases occur in the child-bearing period, and, according to Schroeder, 90 per cent. of the females were women who had borne children. The fact that cholelithiasis occurs in females in the proportion of 4 or 5 to 1 of males is established by all statistics. Tight-lacing has been given a very prominent place in the causation by some authors. In more than half of the female cases the liver has shown signs of pressure of the ribs.

A pendulous abdomen is often found, which may favor the formation of calculi directly in causing a partial ob-

struction of the bile by traction on the common bile-duct.

Langenbuch is of the opinion that the traction of a displaced right kidney on the common duct is a predisposing cause of cholelithiasis to which sufficient importance has not been given. The capsule is attached to the cystic duct, the hepatico-duodenal being continous with the hepatico-renal ligament.

As profession and social position as causative factors, Krauss gives the following statistics of 472 cases in men which came under his observation:—

Physicians, 45.
Officials, 74.
Manufacturers, 19.
Clergymen, 60.
Large landed proprietors, 24.
Merchants and bankers, 40.
Small land-owners, 26.
Military officers, 40.
Professors and teachers, 103.
Tenants, 41.

Over 50 per cent. occurred in active brain-workers who at the same time lead sedentary lives. Krauss gives mental anxiety, chronic constipation, and frequent pregnancies as probable causes. He is also of the opinion that the deposit of fat in the abdomen prevents the active peristalsis of the intestines.

Heredity does not seem to play an important part. Naunyn claims that it would be difficult to estimate this factor in a disease so prevalent. In 60 per cent. of Krauss's patients the disease could be traced in the families of the patient. He has often treated mothers and daughters for cholelithiasis at the same time.

Gout has been looked upon as a predisposing cause. It may act in two ways: by producing a stagnation of bile in one who cannot take sufficient exercise, and by means of toxins which, when excreted by the liver, may bring about a catarrhal inflammation of the ducts.

The relation between diabetes and cholelithiasis has given rise to much discussion. Bouchard found gall-stones present in 165 cases of diabetes. Mayo Robson states that they are rarely found in case of diabetes when nitrogenous food is largely taken.

Cardiac disease tends to the formation of calculi by rendering the patient incapable of much exercise, and by causing passive congestion of the liver. Brockbank found gall-stones in 27 out of 49 cases of heart disease.

Renal calculi were found so frequently in gall-stone cases that a definite relationship was thought to exist between the two conditions. On the other hand, Naunyn has rarely found the two diseases combined.

A villous condition of the inner surface of the gall-bladder has been given as a predisposing cause.

It is generally thought that cancer, with which cholelithiasis is so frequently combined, is caused by irritation of the calculi. It would, however, seem probable that roughening of the surface, catarrhal cholecystitis and cholangitis, which frequently occur in the early stage of the disease, as well as the partial obstruction which must often take place, would all predispose to the formation of calculi.

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Relation of gall-stones to primary cancer of the gall-bladder. Review of literature and personal cases led to the following conclusions:—

1. Gall-stones are met with in from 6 to 10 per cent. of all cases submitted to a pathological examination.

2. Primary cancer of the gall-bladder occasionally occurs unassociated with gall-stones.

3. In the large majority of cases pri-

mary cancer of the gall-bladder is associated with gall-stones.

4. The presence of gall-stones in certain subjects, and doubtless in connection with other predisposing causes, favors a cancerous development.

Two explanations of the frequent combination of cholelithiasis and cancer are given:—

1. Irritative hypothesis: that the cancer is caused by direct irritation of the calculi.

2. The concentrative hypothesis: that the presence of a growth may give rise to those conditions which favor the formation of gall-stones. Kelynack (Practitioner, Apr., '96).

The relation which insanity bears to cholelithiasis has long excited interest. The more frequent occurrence of gall-stones in insane people is probably due, in large measure, to their sedentary habits. The opinion has also been given that great nerve-waste may produce an excess of cholesterin.

Of 50 consecutive necropsies in the female department of Colney-Hatch Asylum for the Insane, gall-stones found in 18 cases, or 36 per cent. In no case had there been symptoms pointing to gall-stones. Half the bodies were markedly emaciated, and only 3 were abnormally stout. Beadles (Jour. of Mental Sci., July, '92).

Literature of '96 and '97.

Gall-stones occur in 3 or 4 per cent. more cases than in the sane. There is no evidence to show that gall-stones have any influence in the causation of insanity. The sedentary habits of the insane represent the principal reason why gall-stones are more frequently found in them. Frances O. Simpson, West-Riding Asylum, Wakefield (Lancet, Oct. 10, '97).

Sedentary habits are, no doubt, a very important predisposing cause. The flow of bile, which under ordinary circumstances takes place under very low pressure, is much influenced by the movements of the body and especially by the movements of the diaphragm. When, therefore, the body is in complete repose, stagnation of the bile will more readily take place, and the soft cholesterin masses which form the nuclei of gall-stones do not pass out of the gall-bladder, but are coated by a more dense layer of cholesterin or bilirubin-calcium, and thus become too large to pass through the cystic duct. Conditions which interfere with the movement of the diaphragm—such as empyema and pregnancy—have the same effect.

Authoritative views with regard to the influence of diet have been divided, and of late years its importance has been much doubted. Experience has shown that, in cases of biliary fistula, farinaceous and saccharin food will produce a dense, thick bile, whereas an albuminoid diet will cause the biliary secretion to be more liquid. A dense, thick bile will act in the same way as if it were stagnant: in favoring the formation of calculi. Frerichs thought that a small number of meals, with too long an interval between them, prevented the proper emptying of the gall-bladder, and thus predisposed to the formation of calculi.

Case of death from intestinal hæmorrhage, preceded by gradual exhaustion, in a woman, aged 76 years, in whom the liver was fatty and the gall-bladder completely filled with calculi. The patient ate large quantities of bread, potatoes, and sweets, and had latterly taken but little exercise. Graham (Can. Pract., Dec. 16, '91).

It was at one time thought that too much lime in drinking-water predisposed to cholelithiasis; this has, however, not been substantiated. Climate does not seem to have any great influence.

A summary of our present knowledge regarding the etiology of cholelithiasis

shows that gall-stones may originate either in the gall-bladder or in the intrahepatic ducts. In a large majority of cases they occur in the former situation and are the result of catarrhal and other inflammations. The formation of bilirubin calculi in the intrahepatic ducts is caused by catarrhal inflammation, probably the result of the excretion of some irritating substance. It is possible, also, that a microbic invasion may take place either through the common bile-duct or from the blood-vessels; but the latter is not likely. Bilirubin-calcium calculi may form in the intrahepatic ducts and pass through into the gall-bladder, becoming the nuclei of larger stones.

The principal predisposing cause is the stagnation of bile, and this may arise either from its inherent density or from partial obstruction. In the various predisposing conditions given it will be found on examination that they all act in the same way, viz.: in lessening the pressure of the flow of bile through the common duct. It is not impossible that chemical conditions, such as have been described by Thudicum and the French writers, may underlie the formation of calculi, but certainly the existence of such conditions has never been demonstrated.

Pathology.—Formation of Calculi.—Cholesterin, the principal constituent of biliary calculi, is constantly found in the bile, being kept in solution by the biliary-acid salts: the glycocholate and taurocholate of soda. It is not found in the blood, nor in the liver, unless there be necrosis of the hepatic cells. It must, therefore, be produced by the epithelial lining of the bile-ducts and gall-bladder. Its precipitation will depend either upon its increased proportion in the bile, or upon the diminished solvent power of the latter fluid. Where both conditions exist together, the process of concretion is still more favored.

Although the quantity of cholesterin in the normal bile is fairly constant, it may be considerably increased by inflammation of the mucous membrane of the gall-bladder and passages. The same condition produces a lessened alkalinity of the bile, which diminishes its solvent power. It is thus seen that catarrhal inflammation at once produces the two conditions favorable to the precipitation of cholesterin. The process may be set up by such germs as the colon bacillus, the typhoid bacillus, and the pneumococcus. The fact that such organisms have been found in the nuclei of calculi confirms the theory of this method of their origin, which was elaborated by Naunyn in his work published in 1892. The presence of a nucleus of bilirubin-calcium or cholesterin is not of itself sufficient to give rise to a calculus. This has been proved by experiments upon dogs. Cholesterin calculi, according to Naunyn, may form in two ways: either with small cholesterin masses as nuclei, or small aggregations of sediment become the centre of calculi. This sediment consists of brownish particles and yellow, gritty masses in which fat-granules and cholesterin crystals are often present.

A comparatively-soft nucleus may be surrounded by a hard layer of cholesterin. When a calculus is once formed it increases in size, layer upon layer. The crystallization of the cholesterin takes place within the calculus after its formation.

The portal of entry of the micro-organism is probably the duodenal opening of the common bile-duct. It is also probable that, in the great majority of cases, the germs pass into the gall-blad-

der and not into the intrahepatic ducts. The possibility of entrance through the blood-vessels must be allowed, but has not been proved.

Naunyn is of opinion that the colon bacillus is the principal agent in the production of calculi. Within the last few years the relationship between typhoid fever and cholelithiasis has been studied by Osler, of Baltimore; Hunter, of London; and others. The frequency with which the latter disease follows typhoid, and the fact that Eberth's bacillus has so often been found in the gall-bladder of those who die of typhoid fever, are interesting facts in this connection.

Literature of '96 and '97.

1. The microbic theory of gall-stones which was promulgated ten years ago is now an established fact.

2. It is probable that the micro-organisms favor the precipitation of certain elements of the bile, but the microbes cause a catarrh, which may not be recognized clinically. The degeneration of the epithelial cells produces the cholesterin and lime. The latter combines with bilirubin to form the insoluble bilirubin calcium.

3. Lithiasis is a result of the infection of the whole biliary tract or of the gall-bladder alone.

4. Calculi may be divided into two classes: those produced by the colon and those by the typhoid bacilli. The colon bacillus is the most frequent cause. Fournier (Origine Microbienne de la Lithiase Biliaire, Paris, '96).

Cholesterin is not wholly of local origin as claimed by Naunyn. R. H. Chittenden (Med. News, May, '97).

Conclusions arrived at, largely from experiments upon animals:—

1. The presence of aseptic foreign bodies in the gall-bladder does not produce inflammation and does not seem to affect its function, if the cystic duct remain potent. There is no precipitation of cholesterin when the bile remains clear and free from microbes.

2. Bile stagnant in an aseptic gall-bladder has no tendency to precipitate.

3. There is greater tendency to precipitation when the infection is from an attenuated, than from a strong, virus. R. Mignot (Thèse de Paris, '96).

Naunyn's theory that gall-stones are the result of catarrhal inflammation of the lining mucous membranes not accepted. In most cases they result from a decomposition of the bile into simpler substances, such as are produced more particularly during the process of so-called spontaneous decomposition after its removal from the body.

Those who look at the formation of gall-stones as simply the result of local changes, and do not study the general constitutional conditions which give rise to them are like those of whom Stromeyer speaks: "They hear the little grass grow while the thunder rolls unobserved in the upper ether." J. L. W. Thudicum (Med. Press and Circular, vol. lxiv, 208-210, '97).

Epithelial degeneration and the presence of albumin are purely of a local character and are the result of catarrhal and other inflammations of the gall-bladder and bile-ducts. Two etiological factors recognized of catarrh: 1. Infection of the gall-bladder with micro-organisms, the two most frequently found being bacillus coli communis and the typhoid bacillus. 2. Excretion of irritant substances through the bile which cause a catarrh of the intrahepatic ducts in which the bilirubin-calcium calculi are formed. These latter may afterward find their way into the gall-bladder. The lime, which is rapidly formed in the catarrhal process, combines with the bilirubin to form a substance insoluble in bile. William Hunter (Brit. Med. Jour., Oct. 30, '97).

Experimental formation of gall-stones. Three drops of a culture of typhoid bacilli were injected in the gall-bladder of a rabbit. At the autopsy, six weeks afterward, two small calculi about the size of grains of wheat were found in the gall-bladder. They were made up of a whitish kernel inclosed in a dark-colored shell. A pure culture of typhoid bacilli was made from the nucleus of one of

Gall-Stones Crystallized around sutures. (Homans.)

ANNALS OF SURGERY.

them. Gilbert and Fournier (Deutsche med. Woch., Dec., '97).

Case of formation of gall-stones around sutures allowed to remain in the gall-bladder after a cholecystotomy. The gall-bladder was entirely emptied of stones in April, 1895, and in January, 1897, several round and oval calculi were found. Sutures formed the nucleus of each. (*See colored plates.*) John Homans (Surg. Annals, July, '97).

Bilirubin-calcium is insoluble in water, and cannot be formed simply by concentrating the bile. It has been found that egg-albumin will aid in the precipitation of bilirubin-calcium from bile. It is probable that albumin may act similarly in pathological processes.

The formation of bilirubin-calcium stones, as has been already intimated, takes place in the intrahepatic ducts. Naunyn and others are of opinion that the calcium results from an inflammation of the lining membrane of the ducts, from the presence of microbes. It would seem difficult to understand how micro-organisms find their way from the duodenum into the smaller bile-ducts, and still more difficult to conceive of their entering the intrahepatic ducts from the blood without seriously affecting the parenchyma of the liver. As has been already noticed, William Hunter, of London, is of the opinion that calculi of the intrahepatic ducts is caused, not by micro-organisms, but by toxins excreted by the liver. The function of the liver as an excretory organ has been amply proved by Schiff and others, and a catarrhal inflammation from this cause seems reasonable.

Spontaneous fracture of biliary calculi sometimes takes place.

Literature of '96 and '97.

Case in which gall-stones had been removed from the gall-bladder of a patient who had died of cancer. There was clear evidence from the shape of the stone that fracture had taken place during life. There was no previous history of injury or of biliary colic. (H. G. Rolleston.)

Concordance with Dr. Ord, that, owing to alteration of the density of the circumambient fluid, the colloid substance of the calculi underwent alteration in volume, either swelling or shrinking, and so led to disruption, which might take place centrifugally or from the surface. (S. G. Shattock.)

The view that spontaneous fracture might arise from an invasion of microbes expressed by some members. Discussion in the London Pathological Society (Brit. Med. Jour., Nov. 20, '97).

Morbid Anatomy.—The gall-bladder may be distended with calculi and little change found except erosion of the mucous membrane, with more or less thickening and infiltration in places. Cholecystitis and pericholecystitis may cause these changes to be more pronounced. Phlegmonous inflammation of the gall-bladder sometimes occurs in acute diseases.

Calcification of the gall-bladder sometimes follows empyema, in which the mucous membrane may be coated or the whole thickness of the wall may become infiltrated with lime-salts.

Distension of the gall-bladder usually arises from the arrest of calculi in the cystic duct. The contents in uncomplicated cases are largely composed of mucus, more or less bile-stained: hydrops felleæ. If at the same time there is an invasion of pyogenic organisms, an empyema of the gall-bladder results.

Ulceration and perforation sometimes occur, allowing the contents of the gall-bladder to pass into the peritoneal cavity.

Literature of '96 and '97.

Two cases of distension of the gall-bladder from flexion of the neck. No gall-stones were found. A. H. Ferguson (Brit. Med. Jour., Nov. 6, '97).

Fatal case of rupture of the gall-bladder. Patient 26 years of age. The gall-stones found their way out of the gall-bladder partly by ulceration and partly from expulsion. Some gall-stones and bile-stained fluid were found in the abdomen, together with the results of general peritonitis. A perforation of the rectum, which allowed fæces to pass out, was also discovered at the post-mortem. The perforation thought to have been caused by pressure of gall-bladder stones on the peritoneal coat of the bowel. The patient lived twenty-five days after the rupture of the gall-bladder. Shadbad (St. Petersburger med. Woch., Jan., '96).

FISTULÆ.—Gall-stones may pass out through the wall of the gall-bladder or ducts into the surrounding structures, producing fistulæ, which may take different directions.

In hepatico-bronchial fistulæ a series of cases of this rare form of disease studied by the writer showed that the opening through the diaphragm into the gall-bladder may arise from a distended gall-bladder passing over the anterior border of the liver, or that calculi could find their way by ulceration through the wall of the gall-bladder and ducts, forming an abscess which may penetrate the convex surface of the liver and the diaphragm. In such cases a cavity is often formed by the presence of intrahepatic calculi and of pyogenic organisms. A direct fistulous opening may take place between the gall-bladder and the stomach.

Literature of '96 and '97.

Case of obstruction of the pylorus produced by a gall-stone and surrounding inflammatory adhesions. There was a direct communication between the gall-bladder and stomach, a cystico-stomachal fistula. Monprofit (Bull. de la Soc. d'Anat. de Paris, May, June, '97).

Fistulous openings into the duodenum or through the abdominal walls are the most common. In the latter case openings may take place in the right hypochondrium, near the umbilicus and above the pubes.

Literature of '96-'97-'98.

Interesting case of biliary fistula into the urinary tract. The post-mortem revealed a fistula leading into an abscess and from this into the pelvis of the right kidney, where a large cholesterin calculus was found. Elsner (Med. News, Feb. 5, '98).

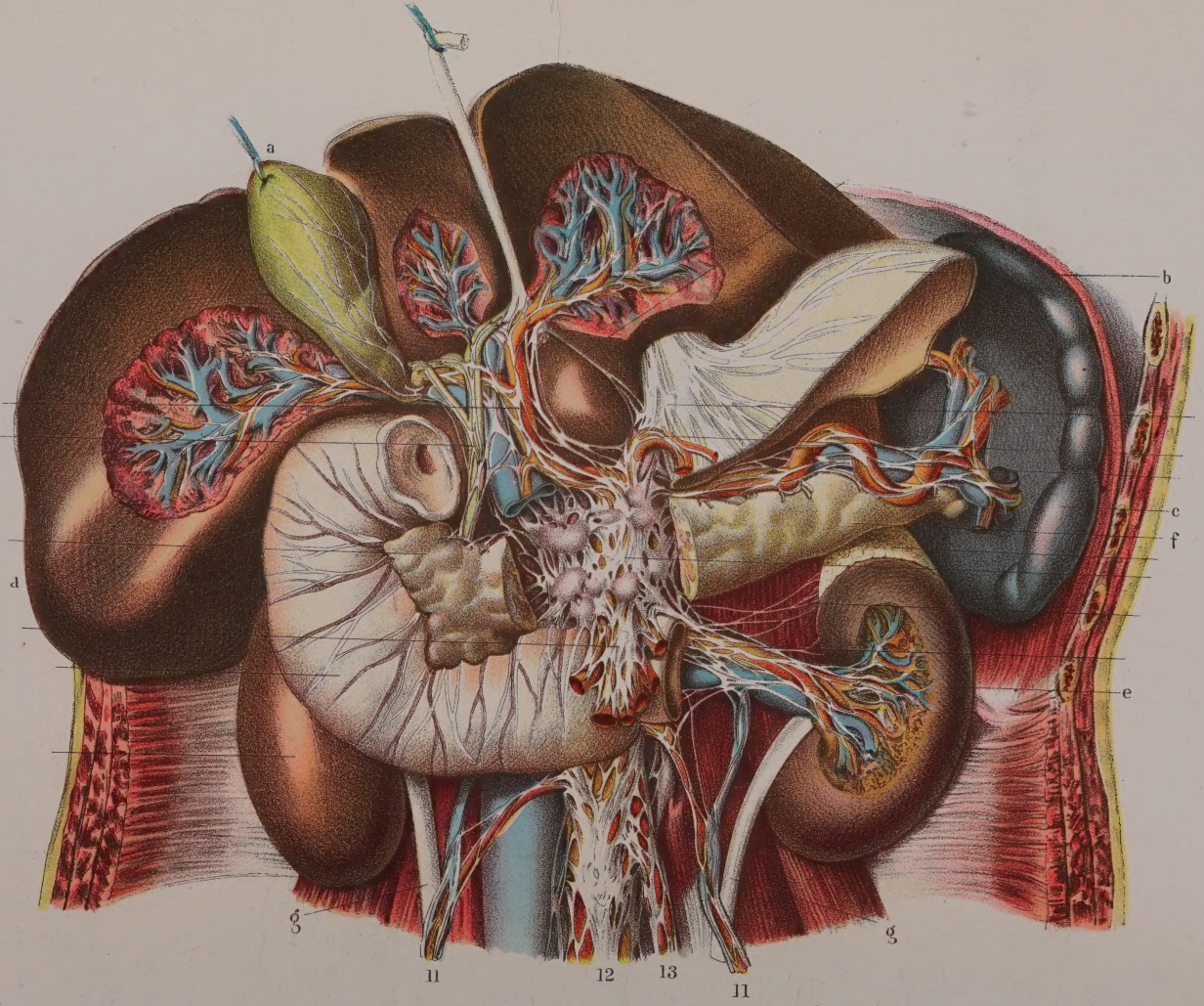
Courvoisier has reported seven cases of urinary fistulæ. Cases of fistulæ into the uterus and vagina have also been reported. The chronic irritation resulting from the presence of calculi in the gall-bladder and ducts may give rise to atrophy or calcification of the gall-bladder and to the formation of diverticula and cicatrices. Thickening of the surrounding tissues is also a common result. In 255 autopsies in gall-stone cases given by Courvoisier, atrophy of the gall-bladder was found in $12\,^1/_2$ per cent. It is the result of frequent catarrhal inflammation. In such cases the gall-stones are found imbedded in the contracted gall-bladder or in diverticula.

Literature of '96 and '97.

The obliteration of the cystic canal, the gall-bladder being aseptic, results in atrophy of the reservoir, the same as if it contained foreign bodies more or less irritating. Arménis (Thèse de Paris, '96).

A calculus in the common bile-duct will, after awhile, produce distension and thickening of the wall of the duct. It sometimes floats in a cavity, often in the ampulla of Vater, acting as a ball-valve, thus causing intermittent or remittent jaundice.

The enlargement of the bile-ducts may extend backward to the smaller radicals. The hepatic cells become deeply stained with bile. In some cases, which are com-



Relation of Gall Bladder and Bile Ducts to other organs.

(The liver is raised.)

a. Gall-Bladder, b. Stomach, c. Spleen, d. Liver, e. Kidney, f. Pancreas.

paratively rare, the connective tissue of the liver is increased, and a calculous biliary cirrhosis results. It is very difficult, in many of these cases of cirrhosis, to exclude the possibility of their being caused by other toxins; alcohol, for instance.

[For the notes of the following case I am indebted to Dr. Dwyer. W. B., aged 65, was taken ill with symptoms of biliary obstruction about two years and a half previous to death. Had pain, jaundice, delirium, and anorexia during this attack, from which he recovered in two weeks.

A year or so afterward he had another attack somewhat similar, but symptoms were not so severe. He recovered partially and was discharged in about five weeks. Shortly afterward the patient began to have chills and became cachectic. Chills became more frequent and severe about two months before death, though there was little or no jaundice up till a few days before the end.

Diagnosis of passage of gall-stone was made at first attack, and at a second attack ulceration of stone into duodenum with development of suppurative cholangitis. (See illustrations. The colored plate shows the normal gall-bladder, but turned upward to correspond with the position shown in the half-tone cut below). He had, throughout the last attack, irregular rises of temperature. J. E. GRAHAM.]

A, Distended gall-bladder; *B*, junction of cystic and hepatic ducts; *C*, cup-shaped depression in surface of duodenum at the entrance of the common bile-duct in which the gall-stone was lodged. (*Dwyer.*)

Treatment.—PREVENTIVE.—The partial or complete stagnation of bile in the gall-bladder and ducts is the principal, if not the only, predisposing cause of the formation of calculi. Any means, therefore, which will increase the watery constituent of the bile and render the flow more rapid will be of value as a prophylactic agent. Means whereby the circulation is stimulated will also be of service. The emptying of the gall-bladder and ducts may be brought about by exercise and by internal medication.

Horseback and bicycle-riding are to be especially recommended, as well as tennis and lawn bowls and so forth. The occasional administration of calomel followed by a saline cathartic is one of the most effectual methods of emptying the gall-bladder. The taking of large quantities of water, especially of Carlsbad or other alkaline water, an hour or so before meals is of service, as the liver is, in that way, flushed out, and the bile flows more freely.

On the question of diet there is much difference of opinion. It is, however, safe to say that starchy and saccharin foods, which render the bile more dense, are to be avoided.

Medical Treatment.—Some writers, particularly those who do gall-stone surgery, consider remedial measures of a medicinal character altogether futile. It is quite certain that valuable time should not be taken up after the failure of drugs if jaundice and fever are present, as the patient may soon be beyond surgical help. The administration of alkaline waters, especially of Carlsbad salts, has been, in many cases, followed by good results.

Naunyn (quoted by Krauss) says: "I have not the slightest doubt but that the Carlsbad cures have the best influence on the course of cholelithiasis. I have seen a considerable number of dangerous gall-stone incarcerations, which have lasted a long time, terminate favorably." Krauss states that the cures can be taken at home and should last from four to six weeks. A bottle of Carlsbad should be taken each day as follows: Two tumblerfuls in the morning before breakfast warmed to 140° or 150°, at an interval of fifteen minutes. In the evening one tumblerful should be taken cold. If the water does not produce a free evacuation of the bowels, Sprüdel salt should be given in addition. Krauss attaches great importance to diet. As a rule, he forbids: fat, vinegar, hot spices, pastry; vegetables, both dried and unboiled; roasted potatoes, and cheese. He recommends the following diet in ordinary cases:—

Breakfast: A cup of tea or coffee, little milk; little sugar, if any; and two or three pieces of rusk or toast, one or two soft-boiled eggs, or some fish or cold meat.

Midday meal: Fish (salmon and eels excepted), roasted meat without sauce, green boiled vegetables or mashed potatoes, stewed fruits without sugar. Drink plain or slightly-effervescing water, red wine (one or two glasses), or weak whisky.

Supper: Cold or hot meat (fresh roasted), tea, wine, or whisky (small quantities). He usually limits the bread to from four to six ounces a day.

The use of olive-oil has still many advocates.

Result of a collective investigation as to the utility of sweet oil in the treatment of gall-stones, undertaken by the Therapeutic Section of the Philadelphia Polyclinic Medical Society. In all 54 cases were reported, with positive relief in 98 per cent. There were about one-third more females than males among the patients. Concordance with D. D. Stewart, that cotton-seed oil is equally efficacious with sweet oil, and that the beneficial action is due to increase in the biliary excretion, with flushing and lubrication of the passages of the liver. Mays (Buffalo Med. and Surg. Jour., Nov., '91).

Literature of '96 and '97.

Results of experiments to test the solubility of gall-stones in olive-oil, almond-oil and petrolein (a tasteless, purified petroleum-oil). In the first series of experiments the gall-stones used had been passed by a patient in whom the olive-oil treatment had been adopted with some success. They were friable and

facetted, and about the size of green peas. In 48 hours 75 per cent. of the weight was lost in those in olive-oil. The same loss was noted in those acted upon by almond-oil, and 73 per cent. in those acted upon by petrolein.

In the second series of six experiments the stones were obtained from the gall-bladder of a patient operated upon. They were larger and harder than the others; about the size of cherries.

The loss in weight was:—

	Olive-oil.	Almond-oil.	Petrolein.
	Per cent.	Per cent.	Per cent.
In 2 days..	32.3	28	17.3
In 4 days..	52.1	50	31.4

In the third series of experiments gall-stones from the same patient as in Series No. 2 were taken, but they were much larger: as large as filberts. The loss in weight was much less than in the other experiments. The experiments demonstrated the solubility of gall-stones in any one of the oils used, also that the loss of weight depended upon the size of the calculi. They also show that the purified oil of petroleum is nearly as good a solvent as olive- or almond- oil. Lindley Scott (Brit. Med. Jour., Sept. 25, '97).

In cases of cholecystotomy, when there is an external biliary fistula and gall-stones still remain in the common choledoch-duct, the injection of olive-oil into the gall-bladder has been recommended so as to enable it to directly exert its solvent action on the calculi still remaining. A case is reported by Morris in which a cure by this means took place after six weeks' treatment.

Calomel, followed by salines, may be of use in emptying the gall-bladder and expelling the calculi if they are very small.

Literature of '96 and '97.

Butter recommended to be taken in large quantities instead of olive-oil for the prevention and cure of gall-stones. Fifteen to 20 grammes (4 to 6 drachms) of butter spread on biscuits are to be given each morning. Felix von Oefele ("Artzliche Rundschau," '96-'97).

Enemata of olive-oil recommended for the treatment of cholelithiasis. A more direct action on the liver is obtained by this mode of administration, while there is less danger of affecting the stomach. This is an addition to our present means of treatment of cholelithiasis. Blume ("Verhändlungen der Congress f. innere Med.," Wiesbaden, '97).

The most effective remedy for biliary colic is an hypodermic of $^1/_4$ or $^1/_3$ grain of morphine with $^1/_{120}$ grain of atropine. Hot applications applied locally afford some relief, and a weak, hot solution of bicarbonate of soda taken into the stomach in large quantities has been recommended.

Olive-oil in from 5- to 10-ounce doses is said to shorten an attack. Glycerin is also credited with value when employed in the same manner.

In cases of cholelithiasis with "recurrent" gall-stones, the administration of turpentine in the following mixture recommended:—

℞ Ol. terebinthinæ, 5 minims.
Mist. acaciæ, ½ ounce.
Sodæ sulphocarb., 20 grains.
Spt. ætheris chlorici, 15 minims.
Aquæ menth. pip., 1 ounce.

Fiat haust. Ter in die sumend. This should be given periodically three or four times a year in small doses. A. W. Mayo Robson (Clinical Jour., Nov. 9, '92).

Surgical Treatment. — Much has been accomplished within the last few years in the improvement of older methods and in the introduction of new plans of operation on the more difficult cases of gall-stone surgery.

Cases have, from time to time, been reported in which a diagnosis of cholelithiasis had been made, and when operated upon gall-stones have not been found. In some of these recovery has taken place in a remarkable way.

Henry Morris (in Krauss, on "Gall-stones") states that there are several cases on record to prove that, where pain alone or pain with jaundice has been such as to reduce patients to the verge of suicide or death, laparotomy and digital examination of the liver and gall-ducts have restored the sufferer to complete good health, though no tumor nor gall-stones have been found to account for the symptoms. Morris found adhesions to the abdominal wall in one case, and in another a general enlargement of biliary ducts from some unknown cause. It is possible that in some of these cases a gall-stone in the ampulla of Vater may be pushed through into the duodenum during the manipulation.

The indications for operation in cholelithiasis are thus given by Mayo Robson: "1. In frequently-recurring biliary colic without jaundice with or without enlargement of the gall-bladder. 2. In enlargement of the gall-bladder without jaundice, even unaccompanied by great pain. 3. In persistent jaundice ushered in by pain, and where recurring pains with or without ague-like paroxysms render it probable that the cause is gall-stones in the common bile-ducts. 4. In empyema of the gall-bladder. 5. In peritonitis starting in the right hypochondriac region. 6. In abscesses around the gall-bladder or bile-ducts whether in, under, or over the liver. 7. In some cases, where, although the gall-stones may have passed, adhesions remain and prove a source of pain and illness. 8. In fistulæ: mucous, muco-purulent, or biliary. 9. In certain cases of jaundice with distended gall-bladder dependent on some obstruction in the common bile-duct. 10. In phlegmonous cholecystitis and in gangrene, if this can be seen and recognized at a sufficiently-early stage of the disease." (Allbutt's "System of Medicine.") Robson does not approve of sounding for gall-stones through the abdominal walls. He also condemns massage of the gall-bladder.

Cholecystenterostomy is recommended for all cases where an opening already exists in the gall-bladder or requires to be made in it, excepting only those cases where the gall-bladder is too small for the use of a Murphy button or where adhesions, etc., render an intestinal anastomosis impossible without kinking or too great tension. The mortality in the seventeen cases in which the Murphy button was used for cholecystenterostomy was *nil*; without the button in the twenty-three cases reported up to December, 1893, the mortality was 35 per cent. Murphy (Med. Rec., Jan. 13, '94).

Guinea-pigs and rabbits are unaffected by removal of the gall-bladder. Oddi's results—namely, that dogs after the removal of the gall-bladder, suffered great hunger, diarrhœa, and emaciation, and that later there develops a dilation of the gall-ducts—unconfirmed. The ligation of single branches of the hepatic duct caused an hypertrophy of those hepatic areas where the biliary currents were unobstructed. In the ligated portions small areas of necrosis were found; also proliferation of the gall-ducts and an increase of connective tissue. Rapid atrophy of hepatic cells and shrinking of the affected lobe occurred, this change being complete in four months, when the lobe consisted of fibrous connective tissue and gall-ducts. In cases where the obstruction of the ducts was temporary the development of ducts and connective tissue was checked, when the ducts became again patent. Even liver-cells regenerated after extreme degeneration. Nasse ("Verhändlungen der deut. Gesellschaft f. Chir.," '94).

When the stone is near the duodenal opening of the common duct, it is safest to remove it through an opening in the intestine. Cholelithotrity may sometimes be justifiable; but, in general, free incision is better and safer. Profound jaundice is not a contra-indication of surgical interference in cases of obstruction from gall-stone. Sometimes the

formation of an anastomosis between the gall-bladder and the bowel is to be desired. The method of stitching with a double row of Lembert sutures preferable to the use of plates or buttons. To avoid cicatricial contraction of the orifice, the incisions made should each be an inch and a half in length. It is better to make the opening into the colon than into the small intestine. Abbe (Brit. Med. Jour., Aug. 26, '93).

The usual incision in operations on the gall-bladder is three inches long in the upper part of the right linea semilunaris. More space may be obtained, if necessary, by a transverse cut at the upper end of this, and Czerny always employs a rectangular incision. Courvoisier prefers a transverse incision just below the ninth or tenth costal cartilage. Persistent biliary fistula, if it give rise to serious symptoms, can only be relieved by cholecystectomy or cholecystenterostomy. Editorial (Brit. Med. Jour., Mar. 16, '95).

A pouch exists behind the right lobe of the liver which has natural barricades separating it from the general peritoneal cavity, and efficient drainage of this pouch is likely to serve a useful purpose in gall-stone operations. It can be efficiently drained through an opening in the parietes near the lower end of the kidney. A transverse is better than a vertical incision in operating for gall-stones and is less likely to be followed by ventral hernia, while giving free access. Biliary fistula results from operations for gall-stones in a considerable percentage of cases in which the gall-bladder has been attached by sutures to the parietes. The method of attaching has little to do with this result, and it may follow when the ducts are patent. The gall-bladder and ducts may safely be allowed to empty into the pouch described if it is properly drained. The gall-bladder should never, except when suppurating, be stitched to the abdominal wall. If the pouch is properly drained (*a*) when the gall-bladder is distended, the opening in it should be closed by sutures and the viscus returned into the abdominal cavity and the drain left until the certainty of its successful closing is complete; (*b*) when the gall-bladder is shrunken and there is difficulty in closing the opening made in it, it may be returned unclosed; (*c*) when a stone is impacted in the cystic duct and evades all ordinary efforts to remove it, the gall-bladder should be excised and the duct ligatured after removing the stone in it; (*d*) when a stone is impacted in the common duct the duct is incised, and, after the stone or stones are removed, the opening may be left unclosed if there is any difficulty in applying a satisfactory suture.

The accompanying cuts (Figs. 1, 2, 3, and 4) illustrate the appearance of the pouch and the points for drainage. Rutherford Morison (Brit. Med. Jour., Nov. 3, '94).

Literature of '96-'97-'98.

I would advise the operation as follows:—

1. Whenever the diagnosis of acute cholecystitis is made, cholecystotomy should be performed without delay.

2. Cholecystotomy should also be performed in chronic hydrops of the gall-bladder.

3. Whenever acute colicky attacks in the region of the gall-bladder, combined with fever, return for a second or third time.

4. Whenever jaundice is present for more than four weeks.

5. In gall-stone ileus.

6. In all obscure cases when inflammatory symptoms in the region of the gall-bladder resembling peritonitis turn up, exploratory laparotomy is indicated. Carl Beck (N. Y. Med. Jour., May 8, '97).

Emphasis laid upon the necessity of interference in gall-stone cases before incurable conditions result from their presence, among which cancer, infection, and suppurative adhesion and thickening around the gall-duct, and intestinal obstruction, which is so often fatal, may be mentioned. Charles A. Reed (Cincinnati Lancet-Clinic, p. 401-405, '97-'98).

Cholecystotomy is the operation of choice in cholelithiasis, and it is considered safer, after opening the gall-bladder, removing the calculi, and ascertain-

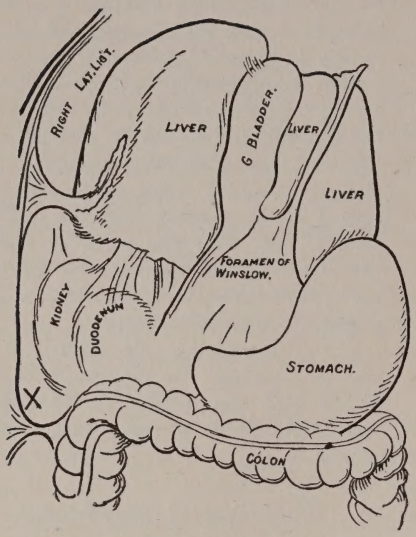


Fig. 1.—The pouch described shown by drawing liver upward. × in all the figures marks points for drainage.

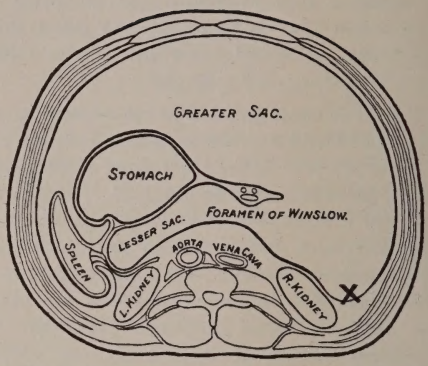


Fig. 3.—Transverse section through centre of pouch.

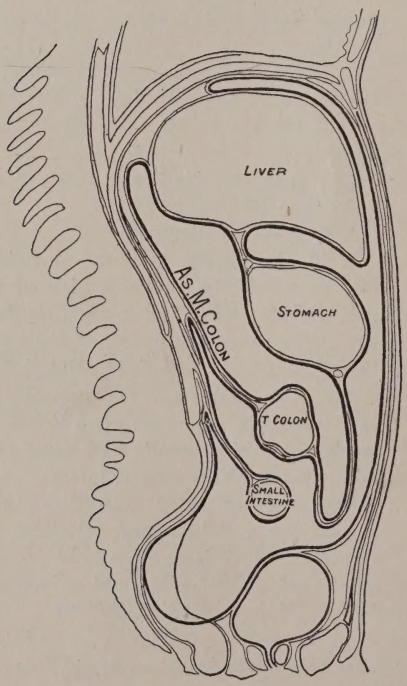


Fig. 2.—Vertical mesial section.

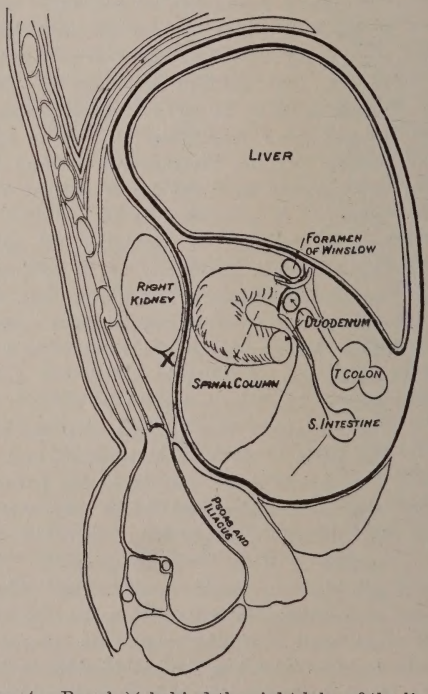


Fig. 4.—Pouch × behind the right lobe of the liver having natural barricades from the general peritoneal cavity.

Posterior hepatic pouch. (*Morison.*)

(British Medical Journal.)

ing that the biliary passages are clear, to suture the walls of the gall-bladder to the edges of the wound than to perform the so-called "ideal" operation of suturing the opening in the gall-bladder and returning it into the abdomen. It is better to suture to the aponeurotic layer of the abdominal wall and not to the skin. Mayo Robson prefers, when there is time, to stitch the peritoneal layer of the gall-bladder to the parietal peritoneum and the mucous layer to the aponeurosis. A drainage-tube is then inserted.

Wolfler's modification of cholecystotomy recommended. It consists in removing all abnormal accumulations and concretions from the sac, closing it with sutures, and attaching it to the abdominal incision. This process is based upon the doubt as to the efficiency of suturing the tissues of the sac, and in case of yielding provides for the escape of bile through the intestinal wound. In the event of failure to effect an outlet for the bile through the common duct, cholecystenterostomy is clearly indicated. The nearer the anastomosis is made to the duodenum, the better. J. McFadden Gaston (Jour. Amer. Med. Assoc., Apr. 1, '93).

When a fistulous opening is left, calculi not removed at the operation may find an exit. When the incised gall-bladder is returned to the abdominal cavity leakage may take place.

When the gall-bladder is contracted and cannot be brought to the edge of the wound, Mayo Robson sometimes tucks down the parietal peritoneum to the gall-bladder and sutures it to the edge of the incision. When he cannot do this, he utilizes the right border of the omentum by suturing it to the gall-bladder opening and to the parietal peritoneum around the drainage-tube and shutting out the general peritoneal cavity. If neither of these methods can be adopted, he passes a drainage-tube through the opening into the gall-bladder and plastic peritonitis shuts off the general peritoneal cavity. The tube is sometimes packed around with gauze. He prefers to drain the peritoneal cavity by passing a tube into the right kidney-pouch through the original abdominal incision or through an opening in the side of the abdomen.

A fistula does not close because the mucous membrane is sewed to the skin, but it does close when united to the cut edges of the peritoneum and transversalis fascia. Perkins (Boston Med. and Surg. Jour., Jan. 25, '94).

That the escape of bile into the peritoneal cavity is not in itself a dangerous event, provided no septic influence is superadded, shown by a case recorded by Hanskehl in which the apex of the gall-bladder was shot off by a bullet, and one in which Thiersch removed 40 pints of bile from the peritoneal cavity after rupture of the gall-bladder. In both there was perfect recovery. Robson (Brit. Med. Jour., Mar. 16, '95).

In cases of obstruction of the common duct, no attempt should be made to suture the opening after the obstruction has been removed, as the patient's condition is nearly always serious and a prolonged operation would terminate fatally. The obstruction should always be removed, if possible. Experiments demonstrating that the peritoneum is capable of bearing the presence of a small amount of bile, but that large quantities or the constant extravasation of it would produce a fatal peritonitis, usually in from twenty-four to forty-eight hours. W. E. B. Davis (N. Y. Med. Jour., Oct. 26, '95).

Literature of '96-'97-'98.

Case of biliary obstruction complicated by peritoneal adhesions. A first incision was made in a line of and down to a distended gall-bladder. A second incision was made in the right flank and about a pint of fœtid and bile-stained pus was evacuated. The abscess-cavity was bounded above by the liver, behind by the colon, the distended gall-bladder on

inner and parietal peritoneum on the outer side. Ten ounces of healthy bile and forty-three gall-stones were removed from the distended gall-bladder. W. F. Brook (Brit. Med. Jour., Feb. 5, '98).

Choledochotomy.—Much attention has been given within the last three or four years to the improvement of this operation, and, although in many cases difficult, it can be performed with greater safety to the patient than formerly. The suturing of the incised walls can be much more easily and completely done, and leakage to a very great extent prevented.

An exploratory operation is indicated when biliary retention has persisted for three months without amelioration. Such an operation is not always easy; when there are adhesions the relations are changed and the gall-bladder is not readily found. By following the course of the umbilical vein the ductus choledochus will be found on a plane oblique to it. If its relations are normal the liver can be elevated and the left index finger introduced into the foramen of Winslow, which is drawn down, while the right index finger follows the left border of the gastro-hepatic omentum. When a calculus is present it is better to perform choledochotomy, when simple pressure of the finger is not enough to cause the stone to pass into the duodenum. The higher up the calculus—that is, the nearer the liver—the more difficult is exploration, incision of the canal, and suture.

In such cases the duct may be left open, as the fistula will heal spontaneously, but drainage must be established in order to isolate the area from the remainder of the abdominal cavity. Quénu (Le Bull. Méd., May 12, '95).

Literature of '96 and '97.

With our present experience and technique we may safely say that choledochotomy, in the majority of cases, is a difficult and tedious operation which may tax to the utmost the resources of the patient, but its results usually are eminently favorable. Jaundice should not be allowed to exist too long. Let me emphasize once more that preservation of life and health in many cases depends upon the proper time being chosen for surgical interference. Lange (Med. News, May, '97).

Case of removal of a gall-stone from the common duct. The finger was with difficulty passed under the duct, and, an incision one inch long being made, two stones and some bile were removed. The incision was then closed with two rows of sutures. Gauze drainage; good recovery. A. J. McCosh (Annals of Surg., Feb., '96).

Dr. W. S. Halsted, in an article in Johns Hopkins Hospital Bulletin, April, 1898, on the use of small hammers and the suture of the bile-ducts, commences as follows: "The surgery of common bile-ducts is still in its infancy. 'Suture of the thickened duct is difficult enough and suture of the normal duct is out of the question,' says one. 'It is not worth while to exercise great care in sewing up a slit in the common bile-duct, for it is almost impossible to prevent leakage, and a little additional leakage can do no harm if one drains,' says another. 'Wait until the common duct dilates and thickens before venturing to open it,' say all surgeons."

Halsted states that he has ascertained from operations on dogs and man that the normal bile-ducts can be sutured easily, accurately, almost infallibly, and without danger of leakage or constriction. He approves of Lange's suggestion to cut through one or two ribs and the diaphragm, if it is necessary thus to render the parts operated upon more accessible. He then describes small hammers, the heads of which, being of various sizes, he inserts into the common duct, after the incision has been made and the stone removed. The contents are thus prevented from escaping, and the duct can be raised or lowered at will

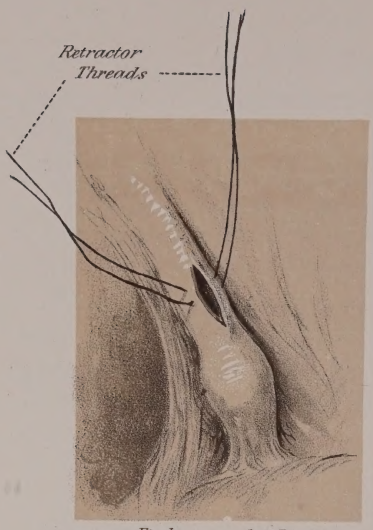


Fig. 1.

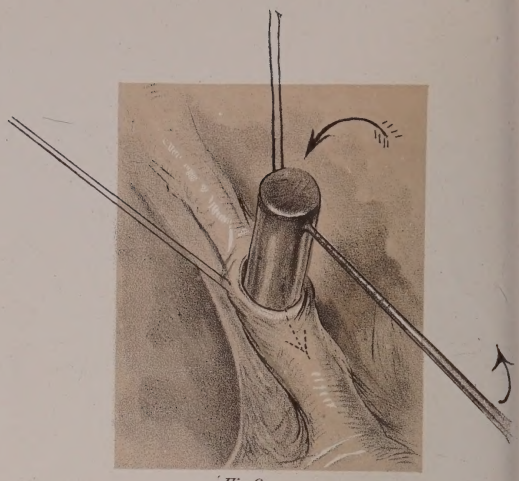


Fig. 2.

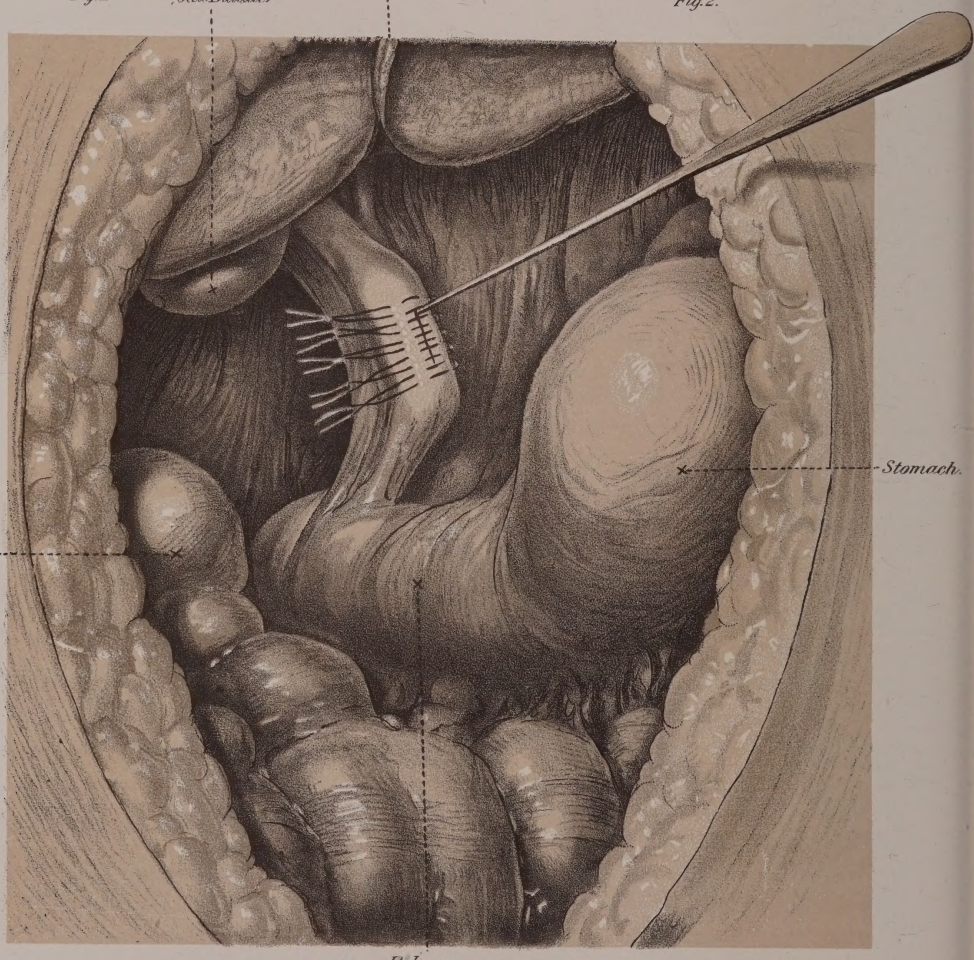


Fig. 3.

Suture of the Bile Ducts. (Halsted.)

JOHNS HOPKINS HOSPITAL BULLETIN.

BURK & McFETRIDGE CO. LITH. PHILA.

by the operator. The wall is more easily sutured over the head of the hammer. He has a series of hammers which he attaches to a long handle, using one of proper size to easily enter the duct. The method is graphically shown in the annexed colored plate, while the hammer and the various diameters of the latter employed are illustrated here.

Literature of '96 and '97.

Series of 209 laparotomies for gall-stones with special reference to 30 cases of choledochotomy. He classifies his operations into five groups:—

1. Those in which the stone is found in the gall-bladder or cystic duct; 97 one-sided and 3 double-sided cholecystotomies, 4 cystendysis and 23 cystectomies. Altogether 127 gall-bladder operations with but 1 death.

2. Two cystectomies and 1 death.

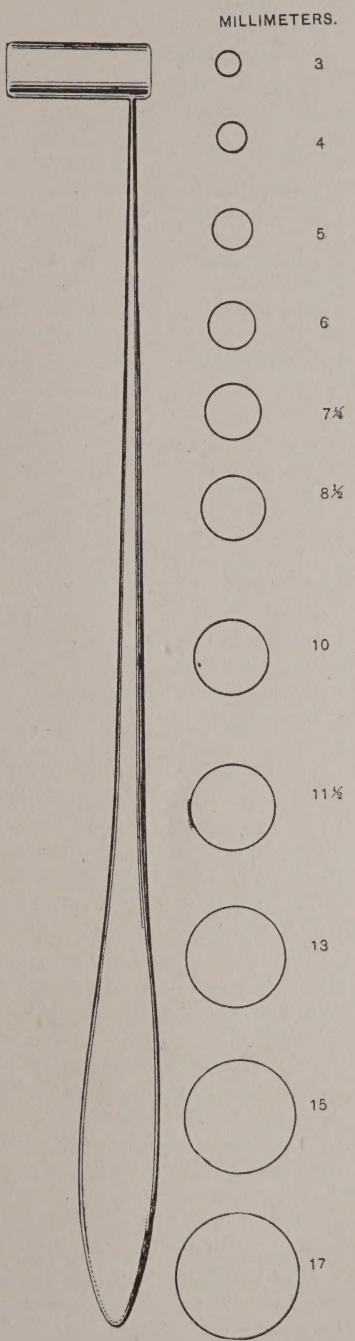
3. Stone in choledoch-duct which could not be moved into the gall-bladder or duodenum; 30 choledochotomies, 2 deaths.

4. Seventeen cases with dense adhesions, fistula, etc.

5. Cases complicated by carcinoma and other conditions necessarily fatal in the end.

The mortality bore a definite relationship to the pathological conditions present. In the 209 laparotomies there were 17 deaths, being 8 per cent.; but the mortality was reduced to a minimum in the case of stones on the gall-bladder and cystic ducts, while it reached 6 per cent. when there were changes in the gall-bladder which demanded cholecystectomy. Suppurative cholangitis proved a very fatal condition. Emphasis laid upon the following three points, viz.: accuracy in the diagnosis of gall-stones, a thorough knowledge of the pathology of the disease, and perfection in the technique of the operation. Hans Kehr ("Verhändlungen der deut. Gesellschaft f. Chir.," xxv Congress, '96).

Morris mentions a case in which, after opening the gall-bladder and removing calculi, stones were found in the common duct which could not be removed. During the convalescence olive-oil was daily injected through the fistulous



Hammers employed in suturing the gall-bladder. (*Halsted.*)

opening. In six or eight weeks the passage became patent and the patient made a good recovery.

Literature of '96-'97-'98.

In the treatment of stones in the common duct, whether impacted or loose, which cannot be extracted through the cystic duct or gall-bladder, choledocholithotomy is the ideal operation. A. H. Ferguson (Brit. Med. Jour., Nov. 6, '97).

Choledocolithectomy is the proper operation for stones in the common duct except in very rare cases, such as those in which the adhesions are so dense that it is impossible to isolate the ducts. In some cases the ducts above an obstruction will be found enormously distended and the walls unhealthy and friable. J. F. W. Ross (Inter. Clinics, Jan., '98).

[Result of anastomosis of the gall-bladder with the colon. J. F. W. Ross reports a case operated on in February, 1896, as still in excellent health. The patient was suffering from a gall-stone impacted in the common bile-duct, producing intense jaundice. At the time of the operation the adhesions were so great that it was impossible to isolate the common duct. The liver was torn in an attempt to accomplish this. As a consequence, an anastomosis was produced between the gall-bladder and the colon by means of a small Murphy button. The button was passed about the sixteenth or seventeenth day after operation. The jaundice rapidly disappeared and the patient soon regained his health. He was seen a month ago in perfect health. The fact that the bile was side-tracked into the colon had no visible ill effect.

Ross also reports having found gall-stones lying in the common and hepatic duct, one beside the other like a row of cobble-stones. The stones in the hepatic duct were found far up to the end of the duct. They were removed by a milking process. In the first place, a silk suture was placed like a running string on the wall of the duct. This was put in position before the duct was incised, so that by pulling on it like a purse-string the orifice could be readily closed and the bile kept from welling into the field of the operation. If the duct is incised first, the bile welling out through the orifice obscures the view. He has adopted this method of procedure on several occasions, and finds it of great service.

After the suture was placed he then made an incision into the common duct inside the oval formed by the suture. With the index finger of the left hand on one side of the duct and the index finger of the right hand on the other side, the stones were gradually squeezed down from the hepatic duct and up from the intestinal end of the common duct to the opening just made and pressed out through it. In this way ten or twelve stones were removed. As the gall-bladder had been previously opened and three stones removed from the interior of the gall-bladder, it was deemed advisable to stitch the gall-bladder to the abdominal wall and place a drainage-tube in its interior. The patient made an uninterrupted recovery and has since enjoyed excellent health. J. E. GRAHAM.]

J. E. GRAHAM,
Toronto.

CHOLERA ASIATICA.

Definition.—Cholera Asiatica is a miasmatic, contagious disease transmitted mainly by human intercourse, but whose epidemic character depends upon outside conditions.

Origin and Transmission.—The original seat of cholera is in India, where it most probably existed long before this century. In Italy and especially on the borders of the Ganges it is always endemic, being produced and entertained by special conditions of the soil, by the infection of the water, etc., and often giving rise to epidemic outbreaks under the influence of high temperature, climatic variations, bad hygienic conditions, certain winds, etc. The epidemics may propagate themselves either by land or by sea, through the great roads of commerce, being conveyed to other countries by caravans or by vessels, forming

here and there many momentary, secondary centres. The agents of transmission are persons infected with cholera or specific diarrhœa, and the linen, clothes, etc., soiled with choleraic dejections, from such persons.

The land-route was followed by the first great epidemic of 1830 and 1848 (the last reaching America), while the second prevailed in the epidemic of 1869 and of 1884. When the cholera proceeded by land, its course was slow and its steps easily marked, by its invading successively Afghanistan, Persia, the Caspian shores, Astrakan, Russia, and then turning toward the west of Europe and America. The epidemics transmitted by sea generally made their first appearance at Mecca or other parts of the Red Sea, and thence were propagated to Egypt, or reached Beyrouth, Constantinople, Marseilles, Toulon, Naples, etc., each of these places becoming a new starting-point for the infection.

Countries spared by this scourge are exactly those places out of such commercial roads, as are the islands of the north of Europe, Faroe, Hebrides, Iceland and Greenland, Baffin and Hudson Bays, Patagonia, western America, Polynesia, Australia, central Africa, etc.

For several epidemics—those of 1852 and of 1859 in Europe afforded a striking example, for instance—a direct transmission of cholera from India could not be traced; so that they must be attributed to a local revival of the cholera germ, with all its primitive attributes, in places where it had previously been carried from India. It seems, therefore, that cholera germs of former epidemics may live as saprophytes and wait until conditions arise, when they again become virulent.

The germs of cholera, when brought into some places, there to give rise to an epidemic of cholera, must find local conditions favorable to their development. Low, damp, marshy lands, large towns with crowded populations, narrow, dirty streets and generally every place in which the sanitary conditions are very imperfect and the inhabitants very poor are always the first and main centres of the disease.

> Decaying vegetable and animal matter, bad drainage, and overcrowding are as much responsible for cholera as bad drinking-water. The regular removal of fæcal matter and efficient surface- and subsoil- drainage will reduce the chance of introducing cholera into a town to a minimum. Rai B. A. Mitra (Indian Med. Rec., Feb. 15, '93).
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> Koch's vibrios traced to farm-yard manure, pigs' fæces being found to contain them. Nevertheless there had been no cholera for years in the region. Kutscher (Zeit. f. Hygiene u. Infectionskr., B. 19, p. 461, '95).

According to Pettenkofer, indeed, the most important part in the development of cholera is played by certain geological conditions of the soil (especially porosity and dampness), and by the variations in the level of the ground-water; so that if such a soil become infected by choleraic germs, finding in it the best conditions for their growth, and, gaining there their virulent properties, the disease diminishes when the ground-water is high, and increases when its level sinks.

> The comma bacillus is not found in sufficient numbers in all cases of cholera to produce the malady. Cunningham, of Calcutta, has searched for the comma bacillus with great care in ten cases without finding it; again, the comma bacilli described by different authors are not identical. Noticeable differences are observed in their morphology, culture, and development. The comma bacillus is, moreover, found in the normal mucous membrane of monkeys and guinea-pigs. Klein (Lancet, Aug. 15, '91).
>
> Investigations on 78 choleraic patients

at the Hôpital Beaujon. In 67 cases the comma bacillus was isolated. During the epidemic the virulence of the micro-organism had diminished, for, in order to kill a guinea-pig, a much larger dose of a culture isolated in September, 1892, was needed than of that isolated in April of the same year. Girode (Comptes-rendus Hebd. des Séances et Mem. de la Soc. de Biol., Oct., '92).

Study of 251 cases of cholera, in no one of which was the spirillum found, but always mixed with one or more bacteria of other kinds. Lesage and Macaigne (Ann. de l'Inst. Pasteur, Jan., '93).

Even by the various methods recommended by Koch for the recognition of the cholera bacillus, and, with the greatest care and the most accurate knowledge of the subject, it is often impossible to come to a positive result. The cause of the disease is not the common bacillus, but some unknown noxious principle. O. Liebreich (Berl. klin. Woch., No. 28, '93).

Personal experiments carried out with a view to determine the specificity of the choleraic bacillus. A sufficient quantity of the micro-organism swallowed to give rise to the disease, and practically negative results obtained. This invalidates the principle of specificity ascribed to the pathogenic microbe, and tends to prove that it is not constantly virulent and able invariably to give rise to cholera. (Pettenkofer and Emmerich.)

Pettenkofer's experiment repeated without injury. At first the experimenters took only small amounts of choleraic cultures without result, then they took larger amounts, and one of them ate an entire culture of a third generation. In this case in thirty-six hours came pain in the bowels, tenesmus, and diarrhœa without particular characteristics. In one other experiment, in which not a sign of sickness occurred, the cholera bacillus was found in the normal dejections. Hasterlik (Corres. f. Schweizer Aerzte, Apr. 1, '93).

Such experiments prove nothing. Everyone who has lived through an epidemic of cholera knows that there always are a large number of slight cases. Such mild cases are really cholera, as it can be shown that the dejections contain large quantities of comma bacilli. Guttmann (Med. Press and Circular, Jan. 25, '93).

While accepting the comma bacillus as the etiological factor of Asiatic cholera, its presence in the intestine necessarily leads to the development of cholera or a cholera-like disease. The presence of comma bacilli in apparently-healthy persons suggests that the bacilli may temporarily or permanently lose their virulence. Rumpf (Centralb. f. klin. Med., No. 25, p. 2, '93).

Lesions of cholera produced by giving intravenous injections of cholera bacilli, pure cultures being obtained from the fæces. If the animal received doses of absolute alcohol for two days before the injections, the predisposition to the cholera infection was very greatly increased. Thomas (Archiv f. exper. Path. u. Pharm., vol. xxii, No. 1, '94).

Experiments showing that the activity of the bacilli in the case of men is not parallel to their virulence in animals. The course of epidemics cannot be attributed alone to the biological characteristics of comma bacilli. It is very probable that the symbiosis of the comma bacilli with other species of micro-organisms found in the dejections and in the intestines of cholera patients plays an important rôle. Blachstein (St. Petersburger med. Woch., Jan. 27, '94).

Study of 293 cases of cholera in Arabia; the comma bacilli found in 280. Also discovered bacilli in his own stools without having any of the symptoms of cholera. Immunity is possibly the result of an attack of cholera experienced in 1892. Karlinski (Centralb. f. Bakt. u. Parasitenk., May 19, '94).

Very severe and even rapidly-fatal cases of cholera occur with all the characteristic symptoms of the disease, yet careful examination fails to show bacilli in the stools; and that, on the other hand, cases which are clinically identical with mild diarrhœa may yet have abundant bacilli in the discharges. Radecki (St. Petersburger med. Woch., Feb. 17, '94).

Strong ground against the power of the cholera spirillum to produce cholera;

conclusions based upon much of the work done in the last two or three years. Zambaco (Gaz. Méd. d'Orient, Mar. 31, '94).

Of course, a polluted water-supply may aggravate an epidemic of cholera by furnishing a good medium of culture, and a good water-supply may, on the contrary, lessen an epidemic; but the spread of the disease, by means of drinking-water, is not satisfactorily explicable.

State of our knowledge regarding the causation of cholera, as shown by the epidemic of 1892-'93. The history of this epidemic shows that the disease does not spread by means of contaminated rivers, since it extended from large cities rapidly toward the interior, in the direction opposite to the course of the stream. Neither did the contamination of drinking-water satisfactorily account for its spread. The dejecta contain cholera bacilli and the cholera contagium,—viz.: the spores which are produced by the bacilli,—the latter being more tenacious of life than the bacilli, and also more virulent. The disease is spread by articles soiled by dejecta or by the diffusion of the dried pulverized dejecta through the air. Consequently cholera epidemics are most apt to arise in dry seasons. The contagium of cholera always enters the system through the digestive apparatus. These deductions teach us the great importance, from the stand-point of prevention, of bringing all dejecta and objects soiled by them under water as soon as possible. Lachmann (Deutsche med. Zeit., Jan. 4, '94).

Vibrios are present in sewage and Seine water, Paris, and in Verseilles drinking-water, when no cholera is present. Sanarelli (Ann. de l'Inst. Pasteur, vol. vii, p. 693, '95).

Same observations in the Spree, Oder, and Havel streams and Berlin water-supply. In the latter two the vibrio was found pathogenic and gave cholera-red reaction. The Massowah vibrio and phosphorescent vibrios from Hamburg are probably the true cholera vibrios. Pfeiffer (Zeit. f. Hygiene u. Infectionskr., B. 1, p. 759, '95).

There are 150 varieties of vibrios differing greatly from Koch's, but growing typical specimens for some time in water. Dunbar (Deut. med. Woch., p. 138, '95).

Evidence showing direct, positive agency of polluted water in the causation and spread of Asiatic cholera. Oetvös (Le Bull. Méd., Jan. 9, '95); Fallot, Cassoute, and Bouissou (Marseille-méd., Oct. 1, '94); Körber (Zeit. f. Hygiene u. Infectionskr., p. 161, '95); von Heusinger and C. Fränkel (Berliner klin. Woch., Mar. 25, '95); Clemow (Brit. Med. Jour., Oct. 13, '94).

Experiments showing that vibrios may survive an entire winter and freezing. Kasansky (Centralb. f. Bakt. u. Parasitenk., p. 184, '95).

Vibrios in fæcal matter, as a rule, die within the first 20 days, seldom living 30. Vibrios are sometimes present without diarrhœa or other choleraic symptoms, even in formed stools. Rumpel (Berliner klin. Woch., No. 4, '95); Abel and Clausen (Centralb. f. Bact. u. Parasitenk., B. 17, p. 77, '95).

Literature of '96-'97-'98.

The water of a town containing sewage in which fæcal material, urine, etc., is present rapidly destroys the vitality of cholera vibrios, and the danger of a spreading of cholera by canal-water or sewage in which no fæcal material or only a very small quantity is present is much greater. Stutzer (Centr. f. Bakt., Parasitenk., etc., p. 200, '98).

But, though Pettenkofer's theory is based upon serious arguments, on the other hand, it is not less demonstrated, according to the views of Koch, that cholera, in a large proportion of cases, is transmitted through drinking-water and several kinds of food, as milk, fresh vegetables, fruits, etc., soiled by the dejecta, showing in the clearest manner possible, that germs, coming from stools of choleraic patients, are swallowed and find their way to the stomach and to the intestine, whose alkaline juice is necessary for their growth, and in which the entire process of cholera runs its course.

Vibrios are destroyed in fresh milk within twelve hours. Hesse (Deutsche Viertel. f. offentliche Gesund., B. 26, p. 652, '95).

Experiments showing that cholera vibrios live at least thirty-eight hours in milk, and that they develop until the milk coagulates at ordinary temperature. They may even live in coagulated milk. Basenau (Archiv f. Hyg., B. 23, H. 2, '95).

The infection, however, may be still inhaled, coughed up, and afterward swallowed; so that a diffusion of the dried, pulverized stools through the air cannot be excluded. But in every case the contagion of cholera enters the system through the digestive apparatus.

Indeed, we are of the opinion that both theories are in accordance with fact, and that, while direct infection through drinking-water and food is an important factor in the propagation of the disease, on the other hand, the development of epidemics and the preference shown by cholera for certain places can only be explained by certain unsanitary conditions and a peculiar constitution of their soil, especially favorable to the life and growth of the cholera germs. Asiatic cholera must be regarded, therefore, as a contagious and miasmatic disease.

Experiments with flies showing that they are most successful infection-carriers. A fly, which had been infected by being put upon a mass of cholera bacilli, was placed on a piece of beef, which, after a time, was found to contain an enormous number of living bacteria. Uffelman (Lancet, July 15, '93).

Series of experiments showing that not only the comma bacillus, but also other bacteria existing in the intestines of choleraic cadavers, are preserved in the intestines of flies at least three days; bacterium thought to be the vibrio Metschnikowi, when removed from the intestines of flies three days after infection, killed a guinea-pig and a pigeon after the same lapse of time (twenty-four hours) as a vibrio received directly from the intestines of a choleraic cadaver. Savtschenko (Wratsch, No. 45, '93).

The danger of infection by the postal service is exceedingly great. A letter infected with cholera bacilli put, as in the ordinary way, into a post-bag was found, after twenty-three hours and a half, to be still covered with living bacilli. On post-cards they were found living twenty hours after infection. On coins the bacilli died with remarkable rapidity, whereas, on woolen and linen stuffs they enjoyed a particularly long life. Uffelman (Lancet, July 15, '93).

It is possible for the cholera spirillum to be taken up in the air in dust, and thus transported. Uffelman (Berliner klin. Woch., June 26, '93).

Literature of '96 and '97.

Account of an outbreak of cholera in Burdwan jail, furnishing strong presumptive evidence in favor of the theory that flies may spread disease. Nine cases of cholera, 4 of which were fatal, occurred in 6 different sleeping-wards. Just outside of the jail-walls, at the corner where the ordinary prisoners were fed, were a deserted compound and row of dirty huts, where a year ago had been a number of fatal cases of cholera. Swarms of flies were blown by this wind from the huts into the jail-yard, where, on reaching the trees and corner of the high jail-wall, they obtained shelter from the storm and settled on the food exposed on plates before the gang which fed at this corner. All the affected prisoners were fed at this place on the evening of the storm. Surgeon Captain W. J. Buchanan (Indian Med. Gaz., Mar., '97).

But, whatever its origin may be, the disease does not attack all those who are exposed to it; in fact, during an epidemic we see that it develops mainly in those who are predisposed to it, on account of previous diseases, dietetic errors, mental or physical strains, and other causes disturbing digestion or generally diminishing the organic resistance of the individual.

The healthy human body does not furnish a congenial ground for the specific bacillus. Out of 39 persons, mostly of the pauper class, who died of cholera, and were examined at the Hospital of St. Peter and St. Paul in 1892, the following results were found as to the presence of other diseases:—

	Cases.	Percent.
Nephritis chronica interstitialis	35	90
Dilatatio ventriculi..	28	70
Sclerosis cranii.....	18	45
Cirrhosis hepatis.....	16	40
Gastritis glandularis.	15	37
Pleuritis adhesiva...	8	20
Atheroma aortæ et arteriarum cerebri.	7	17
Endocarditis vegetativa	4	10
Pachymeningitis	3	7.5

In 21 women, in whom autopsies were made, abortion was found to have occurred 7 times. Rewowski (Archives des Sci. Biol., p. 517, '92).

Alcohol increases six times the degree of predisposition, in a given individual, to choleraic infection, not only by modifying cellular function and causing vascular troubles, but also by decreasing the bactericidal power of the blood. Thomas (Archiv f. exper. Path. u. Pharm., Aug. 24, '93).

In cases of alcoholics mild cholera, like traumatism, is capable of producing delirium tremens, and may also account for a sudden aggravation of light cases. L. Galliard (Archives Gén. de Méd., Oct., '93).

Natural immunity against cholera which, according to Koch, exists in half of the human race. The exact way in which this acts is not yet clear, but it is probable that the toxin generated in the intestinal canal by the vibrios of cholera becomes changed by the nuclein, during absorption, into an immunizing substance, or antitoxin. It is a peculiarity of the living cell to be able to preserve a free acid in an alkaline medium. When the life of the cell is destroyed the barrier is removed to the entrance of the cholera bacilli. Klemperer (Deutsche med. Woch., May 17, '94).

Some persons exposed to action of vibrios remain unaffected. Immunity is not due to killing of all microbes in the stomach. Abel and Clausen (Centralb. f. Bact. u. Parasitenk., B. 17, p. 77, '95).

We see that under certain meteorological changes the epidemics show often quite marked exacerbations, and that, when the private and public sanitary conditions correspond to scientific requirements, the disease is always less grave and more localized than under contrary circumstances.

The marked influence of winds and moisture is undeniable. Rosanoff (La Tribune Méd., Jan. 2, '95).

Prevalence and mortality of Madras Presidency associated with two monsoons caused by rains, induced raise of subsoil-water and development of conditions suitable for seasonable epidemic. W. G. King (Brit. Med. Jour., Feb. 2, '95).

Pettenkofer's view of the important part played by the level of the ground-water in the cholera epidemic in 1892 supported by comparative charts showing the amount of rain-fall, the number of cholera cases, and the level of the ground-water. As the ground-water sank, cholera increased. P. Hauser (La Méd. Mod., June 9, 13, '94).

Symptoms. — The duration of the period of *incubation* ranges in the majority of cases from 36 to 56 hours; it very rarely extends over several days.

The *clinical course* of cholera may be divided into three periods: (1) *premonitory diarrhœa*; (2) *confirmed cholera*; (3) *reaction.*

Premonitory diarrhœa begins more frequently at night, with or without colicky pains, under the form of liquid stools, at first fæcaloid and then bilious and serous, with borborigmus, but without tenesmus. Generally there is no fever, and no trouble of the appetite and of the general well-being; so that patients may not be obliged to go to bed. But, after it has lasted for a more or less

long time (from a few hours to several days), the patient begins to feel a sense of weakness, pains in the limbs, dizziness, shiverings, and mental torpor. Premonitory diarrhœa is always of choleraic nature, as the stools contain the specific germs and may disseminate the infection. It is not constant, being found only in one-third or two-thirds of the cases (according to the different statistics); but it may be the sole manifestation of a very slight cholera.

Confirmed cholera is announced by a change in the aspect of the stools, which, while becoming more frequent, consist of an aqueous fluid, without any fæcaloid smell or appearance, in which many whitish, mucous flakes float, resembling grains of rice (whence their name of "rice-water" or "riziform" stools), formed by the epithelial *detritus* and containing the cholera vibrios. In the meantime vomiting sets in, also of an aqueous material and accompanied by cramps in the stomach and præcordial uneasiness. The thirst becomes burning and insatiable. The urine is scanty, often showing albumin and sugar (which disappear when recovery begins); but in many cases these are totally wanting, a complete anuria being the rule in grave forms. The tongue is whitish, large, and damp. Palpation of the abdomen shows the anterior wall depressed and somewhat hardened. In proportion to the increase of the diarrhœa and vomiting the patient grows weaker and weaker; the extremities become cold; the pulse small, weak, and accelerated; painful cramps develop in the calves; sinking of the features with sharpened, cold nose, sets in; and the circulation becomes sluggish, constituting together the "algid stage."

This period may last from a few hours to one or two days, and may end in recovery with a progressive amendment of all the symptoms, constituting then the form to which the name "cholerine" was given by some authors; or it may end in death with symptoms of profound exhaustion, or finally pass, as we have said, into the algid stage.

This is announced by a lessened frequency and abundance of the dejections, which sometimes cease altogether. In a few hours, however, the patient's general condition grows rapidly worse; the countenance is altered,—the cheeks become hollow, the eyes sunk deeper in the sockets, are encircled by a black ring; there are pains in the head, ear-tinglings, dizziness, and blurred vision; the voice becomes hoarse and is soon extinguished. A feeling of anxiety assails the patient, who suffers from the most excruciating vomiting, hiccough, and cramps in the calves. Cooling of the surface increases, all external parts being, as it were, frozen; but the patient feels an internal, very troublesome heat, explained by the fact that the temperature of the skin, mouth, etc., is much lowered, while that of internal organs is raised and even febrile. At the same time the skin takes a bluish tinge, with black marble-like veins coursing over the hands, feet, penis, and with increasing cyanotic dark hue of the nails. The pulse becomes weaker and smaller, until it disappears, first from the radial arteries and then from the crurals and even the carotids, while the heart-beats gradually disappear, the sounds becoming weaker until finally only the second sound is heard. To this great emaciation is added, the body growing thin and the skin wrinkled. Breathing is frequent and difficult; every secretion is dried up, with the exception of that of the sudoriferous glands, a cold and clammy sweat covering the cutaneous surface. At the end

of this stage the patient becomes extremely apathetic and somnolent, loses consciousness, slowly turning his eyes toward a person speaking to him, and at times answering some words with great fatigue, but immediately falling again into stupor. A period of agitation, during which the patient tries to rise and utter vague words sometimes precedes this stage of collapse, which generally—in more than three-fourths of all the cases—grows worse, and ends in death. The whole duration of the algid stage is from a few hours to two or three days.

Signs of death in choleraic patients. The cessations of respiratory and cardiac movements are not certain signs of death in this disease. The author proposes the following: 1. With an œsophageal sound, introduce by the mouth an abundant quantity of water into the digestive tube. The epithelial *débris* which covers the mucosa will become softened and the water be absorbed. 2. Place the body in a bath, at a surrounding temperature, the head naturally above water. 3. In a patient considered dead from cholera, make a small incision in the abdominal wall and inject an abundant quantity of warm water into the peritoneal cavity,—an operation which, in the event of revival, would be inoffensive. Netter (Revue Méd. de l'Est, Aug. 18, '92).

Reaction.—When death does not take place during the algid stage, symptoms of improvement may show themselves: the cyanosis disappears, the skin gains some warmth, the urine begins to flow again and is deep colored, charged with urea and chlorides and very often albuminous; at the same time the pulse resumes its strength, while its frequency decreases; the voice returns, breathing becomes regular, painful cramps disappear, little by little the different functions are re-established, and after some days the patient enters into a state of complete convalescence.

But the reaction does not always take such a favorable course. Many of the choleraic symptoms (anuria, cooling of the skin, difficult breathing, etc.) persist or reappear, and digestive troubles, headache, nervous disorders, fever, and general depression follow, ending in a form very like typhoid fever; whence its name of *cholera-typhoid.* Such cases may run toward a lethal termination, delirium or coma and adynamic symptoms supervening; but they may also end in recovery. In other cases the reaction may be very sluggish, each function requiring a long time to become regular, and a remarkable degree of weakness, somnolence, with scanty, albuminous urine, persist until convalescence sets in.

But how are the symptoms of cholera to be explained? Several theories have been proposed to solve the question; but it cannot be said to be definitely settled. It seems, however, that no better explanation can be given than that of the effects of the cholera vibrios after their penetration into the intestine; that is, a direct injury to the mucous membrane of the gut and the elaboration there of one or more poisonous substances ("choleraic toxins"), which enter the circulation. The direct injury, under the form of a specific enteritis, gives rise to dehydration of the organism, for the great loss of water through vomiting and diarrhœa, which not only deprives the blood of its water, but indirectly subtracts from the tissues their water-component. As a result, the blood can no longer get rid of the regressive products physiologically eliminated by it, nor perform the function of hæmatosis, while the anatomical elements are affected in their metabolism. On the other hand, the toxins, acting on the nervous system, mainly through a lesion of the sympathetic system of the abdomen, exert a general depressing influence.

The action of cholera toxin is to produce an intestinal lesion leading to increased virulence of vibrios normally present. The vibrios are not killed in the intestines, but they can be cultivated from the contents. Sanarelli (Ann. de l'Inst. Pasteur, Mar. 25, '95); Kutscher (Zeit. f. Hygiene and Infectionskr., B. 19, p. 461, '95).

The cholera vibrio is considerably modified by micro-organisms which may surround it. The immunity and susceptibility depend upon other microbes in the intestinal tract. Koch's bacillus nevertheless remains the specific cause of cholera. Metschnikoff (Ann. de l'Inst. Pasteur, Paris, p. 529, '94); Fawitzky (Wratsch, Nos. 47, 51, '94); Rontaler (Münchener med. Woch., May 21, '95).

There is no antagonism between the cholera vibrio and the comma bacillus. Kempner (Centralb. f. Bakt. u. Parasitenk., B. 17, H. 1, '95).

Several complications may be observed during the period of reaction, among which the following are more common: Cutaneous eruptions (papulous erythema, urticaria, miliaria, zona, roseola, petechiæ, vibices, boils, etc.), œdema of the glottis, diphtheritic angina, mumps, thrush, dysenteric enteritis, bronchitis, pneumonia, cerebral congestion, meningoencephalitis, hæmorrhage, and softening of the brain, which may give, of course, a great variety of clinical aspects to the disease.

Two cases of an eruption of the skin during the course of cholera. It was especially abundant on the back, abdomen, and thighs, and consisted of small, round, more or less irregular maculæ, about the size of a dime. In one case there was also intense pruritus. The eruption disappeared in a couple of days and no desquamation followed. Didier (La Normandie Méd., Dec. 1, '92).

Study of ten cases of cholera in pregnant women at Hamburg. While in most infectious diseases the fœtus is expelled, in cholera it dies in the uterus or is retained. Klautsch (Münchener med. Woch., Nov. 29, '92).

Case of acute maniacal exaltation in the convalescent period, which ended in recovery in two weeks. B. Gridenberg (Wratsch, No. 4, '93).

Convalescence, as a rule, is long and often complicated with dyspepsia, diarrhœa, palsies or spastic disorders in the limbs (sometimes in form of tetany), and mental troubles. Anæmia is present in a large proportion of cases.

An attack of cholera does not give immunity; so that even after recovery has taken place a new infection is possible.

The *clinical forms* of cholera may be very different. The most common is that described, in which the disease runs through its typical periods; but it may limit itself to the first stage, being a choleraic diarrhœa or a *cholerine*, or it may, from the beginning, show the gravest symptoms of confirmed cholera, rapidly passing into the algid stage. Between the slight and the grave form there are all the possible intermediate varieties. But there are two other forms worthy of mention: the "foudroyant" and the "dry" cholera. The true cholera foudroyant or *cholera siderans* is generally rare and mostly observed in India; the disease then kills in a few hours or even minutes; or—as observed in European epidemics—death ensues after 12 to 24 hours. The name of "dry" cholera is given to those cases in which there are no diarrhœic stools; intestinal exudation really takes place, but, probably on account of intestinal paralysis, the fluid materials are not thrown out. These cases are often rapidly fatal.

Diagnosis.—In grave cases of cholera the diagnosis is not difficult, especially when an epidemic of the disease exists. Sometimes, however, the clinical appearance of the disease may be very like that of malarial choleriform pernicious fever and of various kinds of chemical poison-

ing. The confusion between cholera and malaria may arise especially in countries where both infections are endemic, such as in India. Then, besides the bacteriological examination showing the specific germ in each of them, the effects of quinine may indicate an important difference in the character, malarial fever ordinarily yielding to its action, while cholera generally runs its course despite the largest doses. It may happen, however, that both diseases attack a person at the same time, and then symptoms of each are observed, giving rise to a mixed form, while necropsy shows the lesions of either infection distinctly developed. Poisoning by tartar emetic or arsenic, the symptoms of which resemble very much those of the choleraic algid stage, is recognized by the lesions of the mouth and lips, by the vomiting being painful, burning, and preceding diarrhœa, and, in doubtful cases, by chemical analysis of vomited matters.

But a much more important diagnostic question, arising especially at the beginning of an epidemic or when an invasion of cholera is to be feared, relates to slight or suspected cases, which are marked only by a simple diarrhœa possessing no specific character. It is of the greatest importance to ascertain, on account of prophylactic measures to be at once adopted, whether they are or not of choleraic nature. The diagnosis can only be made by means of bacteriological examination; fortunately this is quite easy, because the cholera vibrios always show themselves in the first diarrhœal stools, and because in many cases the simple examination of a cover-glass preparation of the stools may be sufficient to make a very probable diagnosis.

When mixed with the serum of immunized guinea-pigs, and inoculated into the peritoneal cavity of susceptible animals, virulent cultures of the spirilla in large dose remain innocuous; on subsequent examination of the peritoneal contents the bacteria can be seen to have undergone disintegration to a greater or less extent, dependent upon the relative immunizing strength of the serum of the immunized animal. This power of destroying the cholera spirilla is believed to depend upon the presence in the serum of certain antagonistic substances which have a distinct inhibiting influence upon the vital processes of the bacteria.

Investigations show that no other species of bacteria is affected in the same way by mixing with the serum. Hence the following test proposed: A loopful of the culture to be tested is mixed with a cubic centimetre of bouillon, to which ten times the amount of serum necessary to protect a guinea-pig of 200 grammes weight from a similar dose of virulent cholera spirilla has been added, and the whole is at once inoculated into the peritoneal cavity of a young guinea-pig of from 200 to 300 grammes weight. In the inoculation care should be taken to avoid injury of the intestines, and the cultures employed should be recent and should have been shown to consist of well-formed and actively moving germs.

As control, a similar quantity of the same culture is mixed with a cubic centimetre of bouillon as before, an amount of ordinary guinea-pig serum equal to the amount of immunizing serum made use of in the original test is added, and the whole is inoculated into another guinea-pig.

In twenty minutes some of the peritoneal contents in each case is withdrawn by means of glass pipettes, and is examined. If the bacteria are the specific germs of cholera they present a very different appearance in the two cases. Those obtained from the control-animal are well formed, active, and seem to have multiplied. Those which were exposed to the action of the immunizing serum are small, misshapen, immobile for the most part, and apparently dead.

Unless a distinct difference is observable between the bacteria in the two experiments the micro-organism under examination must be regarded as probably

not the cholera vibrio, since the change described is very constant in the case of the cholera germ, and has not been observed to occur with any other under similar conditions. Pfeiffer (Zeit. f. Hygiene u. Infectionskr., vol. xix, p. 75, '95).

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Serum diagnosis: When the blood-serum of an animal gives a good reaction in the fresh state, the reaction may also be obtained by moistening a drop of the dried blood with water and mixing it with an actively-motile choleraic culture. Wyatt Johnston and E. W. Hammond (N. Y. Med. Jour., Nov. 28, '96).

According to Blachstein, chrysoidin produces agglutination in cholera cultures in exactly the same manner as the diseased serum of immune animals, and does not produce agglutination in any other form of vibrio. Personal experiments showing that the chrysoidin reaction was not specific for cholera. Several vibrios are affected, and among them is included the vibrio of Asiatic cholera, and it is not the most sensitive. Walter Engles (Centralb. f. Bakt., Parasit., u. Infectionskr., Jan. 20, '97).

In 11 cases examined the agglutination of the cultures of the cholera vibrio was shown 10 times by the serum; twice on the first day of the disease, 4 times on the second day, 3 times on the third day, and once on the fourth day. The reaction was particularly distinct in 2 of the patients from whom the blood was taken on the third day. The phenomenon of agglutination ascertained by them was absolutely typical. Achard and Bensaude (Presse Méd., Sept. 26, '97).

Bacteriology.—The specific germ of cholera Asiatica is now—thanks to the researches of Koch and of many other authors—perfectly known. It is found especially in the mucous flakes of the stools (and in the vomited matter). When these are spread upon an object-glass, dried, and stained with one drop of methyl-blue, it appears in the shape of rods, measuring 1.5 to 2.5 microns in length, and 0.5 to 0.6 micron in width, and being generally curved, whence the name of "comma bacilli" or "bacilli virgula" given to them. Sometimes, when two of them are joined at their extremities, in a direction opposed to their concavity, the resulting form is that of an italic *S*, and when several bacilli are joined to each other, their shape becomes that of a spiral (choleraic "spirilla"). Cholera bacilli are very movable and endowed with oscillatory movements resembling those of spermatozoa, and also with progressive movements. They are easily cultivated in several culture-media, as in broth and upon agar-agar at the temperature of the human body, upon gelatin plates, which become slowly liquefied, and upon potatoes, meat, eggs, milk, and several other kinds of food. The broth-cultures produce indol and nitric acid (indol-nitrous reaction) and give rise to a peculiar reaction with hydrochloric acid, assuming a violet-pink color, whose intensity rapidly increases during half an hour. This reaction, to which the name of "cholera red" was given, is a valuable diagnostic sign of cholera vibrios.

Cholera vibrios can live only for a short time in fæcal matter, seldom longer than two or three days; so that the advisability of immediate examination of the dejecta is evident. They live, on the contrary, very long in the soil, especially when they find in it a proper nutritious material; it seems rather that their virulence is then heightened, the elaboration of their poison becoming more rapid and intense. They can live, also, on the outer surface of fruits and vegetables (the duration of their life being then from one to six days) and even on the cut-surface of these, where their life may last for a time ranging from one hour (on very acid fruits) to two weeks.

Cholera vibrios can grow freely in water, especially when it is stagnant and polluted with organic matter; and it has been shown that they can live for many days even in bottled water.

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The bacilli are destroyed if they are in free contact with the air while exposed to the sunlight, but the colonies in the interior of the culture-media are aided in their growth, the sunlight serving as a sort of incubator. When the medium is plentiful, there is more growth than destruction. Virulence is not diminished in those bacteria that show growth. Therefore bacteria in the deeper portions of water are not affected by the solar rays, while those floating on the surface may be destroyed; conclusion drawn that "too much reliance should not be placed on the bactericidal action of sunlight." F. F. Westbrook (Jour. of Path. and Bact., Jan., '96).

As for the action of high or low temperature upon them, we know that the best temperature for their growth is between 30° and 40° C.; that under 160° C. their growth is checked, but their vitality is preserved, even if zero or below zero is reached; they have been found to resist a temperature of —31.8° C. (24° F.), so that it may be supposed that the germs may survive an entire severe winter. On the contrary, they are killed after some days by a temperature of 50° C., and in a shorter time by a temperature of 75° C. Direct sunlight diminishes, but does not destroy, their vitality and virulence.

A distinct degree of alkalinity is necessary for their best growth (this being the reason of their development in the intestine), while nearly neutral media are very unsuitable, and acids are decidedly inimical to them; hence they cannot live in the stomach. Sulphuric, hydrochloric, and phosphoric acids, fresh lemon-juice and wine and beers containing a somewhat large proportion of acids, are all able, in a different degree, to kill them. Among the chemical substances having a marked microbicidal action upon cholera vibrios, the most energetic are corrosive sublimate (1 to 10,000), sulphate of copper (1 to 25,000), and quinine (1 to 5000). Mustard-oil and volatile essences generally display a similar action.

Experiments showing that a distinct degree of alkalinization was necessary for the best growth of bacilli, while nearly neutral media were very unsuitable. Sulphuric and phosphoric acids were decidedly inimical to the development of the germs. A. Stutzer and R. Burri (Zeit. f. Hygiene u. Infectionskr., B. 14, '93).

Asiatic cholera is a *nitrate* poisoning, the result of the growth of the specific bacterium. Emmerich and Tsuboi (Münchener med. Woch., June 20, 93); Klemperer (Berliner klin. Woch., p. 74, '93).

If the theory of Emmerich and Tsuboi upon cholera as the result of nitrate poisoning produced by the bacilli is true, more than one cause must act to produce cholera. Not only are the bacilli necessary, but the nitrites also, upon which they are to act to produce nitrates. The presence of carbohydrates is a further essential. R. J. Beck (Med. Corres. des württembergischen Arzt. Landesvereins, Dec. 18, 28, '93).

The specific nature of the comma bacilli is proved by their being found exclusively in the intestinal contents of choleraic patients; but it is proved, too, by experimental production of a cholera-like disease in animals through ingestion or inoculation of their cultures. Indeed, Koch, having previously alkalinized the stomach-contents of guinea-pigs, introduced 10 cubic centimetres of broth-culture of comma bacilli and immediately afterward injected into the peritoneum 1 cubic centimetre of tincture of opium, and succeeded in producing

an intestinal lesion with a flaky, diarrhœal fluid: a pure culture of comma bacilli. Other experimenters, by inoculating such a culture into the peritoneum, observed in guinea-pigs and rabbits a very grave disease, with extreme weakness, low temperature, and death in collapse. Inoculations of choleraic virus in man, however, gave no result.

Cholera vibrios vary to a considerable extent in their pathogenic attributes and chromogenic properties, not only when they grow saprophytically outside the body, but also when they are obtained directly from the intestine of a choleraic patient; so that many forms of them have been described as different organisms, while they are only peculiar varieties of the same germ. Moreover, it seems highly probable that their symbiosis with certain species of microbes found in the dejections and in the intestines of cholera patients play an important part in the increase of their virulence, while some other intestinal microbes may, on the contrary, retard their growth and lessen their virulence.

Attention called to the inhibiting action of lactic acid upon the cultures of the spirillum. Ferrani (Revista de Ciencias Médicas, Sept., '92).

The cholera spirillum secretes a substance which is inhibitory to the growth of the bacillus coli, bacillus typhosus, bacillus anthracis, and bacillus pyocyaneus. Gabritschewsky and Maljutin (Centralb. f. Bact. u. Parasitenk., June 15, '93).

There are not different species of the true cholera vibrio, but the changes which occur when it is grown under different circumstances are not constant and are unessential, the typical forms being obtained again from the changed ones. Friedrich (Centralb. f. Bakt. u. Parasitenk., May 19, '94).

Pathology.—The characteristic lesions of cholera are found in the small intestine, whose inner surface is covered by a whitish, creamy lining, extending from the pylorus to the ileo-cæcal valve. Its contents are generally made up of the well-known rice-water material; this has a neutral or slightly-alkaline reaction, and contains only 1 to 2 per cent. of solid matter (chloride of sodium, carbonate of ammonium, a little urea, and traces of salts of potash); it is devoid of albumin, coloring substances, and biliary salts. The mucous membrane, after the lining has been removed, shows a red coloration, more or less marked, according to the period of the disease, and a number of small, round prominences, made by swelled folliculi: "psorentery." In a later stage the lesions are more pronounced: the intestinal contents are bloody, the folliculi are ulcerated, and the mucous membrane shows a more or less extended gangrene. The large intestine is also extremely hyperæmic, studded with hæmorrhagic patches and ulcerations, and is filled with black, bloody, fœtid, fæcal matter. Deepening of the ulcerations may give rise to perforation, with all its dire sequelæ. Microscopical examination shows a variable degree of swelling and clouding of the epithelium, and extensive desquamation of the small intestine. The adenoid tissue of the mucous membrane and of the villi is filled with embryonic cells, and this cellular infiltration is also found in the follicles and in Peyer's patches. The muscular layer is unaffected; the subserous connective tissue is infiltrated with leucocytes, while the epithelial layer of the peritoneum has disappeared. Anatomically, therefore, the intestinal lesion may be regarded as an acute desquamative enteritis.

The fluids, especially blood and urine, may be very toxic and reproduce typical symptoms of mortal cholera in animals. Bosc (Ann. de l'Inst. Pasteur, June 25, '95).

There is always a more or less severe glomerular nephritis in the algid stage. Pernice and Scaglioni (Riforma Medica, Oct. 19, '94).

In the kidneys the pathological changes are those of a more or less severe glomerular nephritis, or, according to Leyden, of a coagulation necrosis of the epithelium without any inflammatory action. In the former case the morbid changes would be explained by the elimination of toxins passing from the intestine into the blood; in the second by alterations in the circulation due to the profuse loss of water. An epithelial desquamation is observed on the mucous membrane of the bladder, ureters, and the pelvis of the kidneys. The spleen is hard and rather small; the liver is congested and its cells have undergone granular degeneration.

As for the cerebral changes, both in the algid stage and in the period of reaction, they are likewise of the nature of acute degeneration and necrosis.

Cerebral changes in Asiatic cholera in algid state, as well as in reaction period, of the nature of an acute degeneration and necrosis, and not of a perivascular inflammation. Tschistowitsch (St. Petersburg med. Woch., Aug. 17, '95).

Prognosis.—Cholera Asiatica is always a serious disease, even when its symptoms do not apparently show a specially grave character. Considering its insidious tendency and the probability, never lacking, of lethal accidents in every period of its course, the slightest forms of diarrhœa may be regarded, during an epidemic, as the onset of a fatal affection. In the algid stage, of course, the prognosis is still more unfavorable, and such symptoms as anxiety, agitation, collapse, weakness; quickness and, moreover, disappearance of the radial pulse; anuria, coma, delirium, and convulsions are almost without exception of very ill omen. As for the period of reaction, the prognosis becomes bad when cerebral or pulmonary complications occur, or if its course is irregular.

At the beginning of an epidemic, the average mortality from cholera is 50 to 60 per cent. and even higher, while at the end, slight forms generally prevailing, it grows progressively less. The largest proportion of deaths occurs in children and old people, the ill-nourished, enfeebled, paupers, drunkards, and those affected with debilitating diseases, especially dysentery, cancer, consumption, insanity, etc.

Whatever may be the gravity of the symptoms during the algid stage, even if there be intense cyanosis, if the normal or contracted pupils remain mobile,—that is to say, if they dilate when the eyelids are closed and return to their primitive diameter as soon as the lids are opened,—a favorable prognosis may be given. Coste (Revue de Méd., No. 12, '90).

The prognosis of Asiatic cholera in young children is exceedingly bad. Of 4129 infants, aged 1 year and under, 80 per cent. died; of 1701 children, from 1 to 5 years, 75 per cent. died; of 1731 children, from 5 to 15 years, 45 per cent. Hoppe (Deutsche med. Woch., Nov. 9, '93).

There is a urinary crisis in patients who recover, characterized by the discharge of abundant urine of low specific gravity, rich in urates, but poor in chlorides. As convalescence becomes more marked, the proportion of urea diminishes, that of the chlorides increases, the specific gravity grows greater, and the quantity of urine returns to normal. Carrieu (La Méd. Mod., Dec. 30, '93).

Prophylaxis.—Prophylactic measures are of the utmost importance. The importation and propagation of cholera must be thwarted and healthy persons must be protected against contagion. The measures necessary may be summed up as follows: A careful examination of

persons coming from infected places; isolation of those found ill or simply suspected and of their nurses; thorough disinfection of clothes, linen, premises, dejections, rooms, drains, etc. For individual prevention it is necessary to drink only boiled water, to avoid every dietetic error, excess, mental or bodily strain, cold; and, while no radical change ought to be made in the ordinary alimentation, the food must be of good quality and vegetable products should always be cooked.

Haffkine's prophylactic method, based on the inoculation of serum of immunized animals, has been tried with satisfactory results in India; but the duration of the protection afforded by the inoculation, and for some authors the efficiency of the protection itself, is still a matter of doubt.

An experimental inquiry of the bearing on immunity of intracellular and metabolic bacterial poisons: As far as the cholera spirillum is concerned, (1) any one mode of immunization will protect an animal against an infection by any other form of inoculation used; (2) the serum of an animal immunized by any one method also protects guinea-pigs against an infection by any other forms of inoculation; (3) the distinction between an "intracellular" and a "metabolic" poison in their relation to artificial immunity must not be made too narrow. Kanthack and Westbrook (Brit. Med. Jour., Sept. 9, '93).

The milk from an immunized goat has the property of conferring immunity to cholera, but not when introduced into the system by way of the stomach. It confers immunity at once, but is of no avail if given shortly after the injection of the cholera germs. Ketscher (Archiv f. exper. Path. u. Pharm., Nov., '93).

Conclusion against Haffkine's anticholera inoculations; we have no certainty that we are protected against the specific poison in the intestines, however carefully we may be protected against the effect of intracellular poison. Klein (Brit. Med. Jour., Mar. 26, '93).

Endeavor to reconcile the various divergent views which have resulted from the studies of different observers: There are in the cholera vibrios distinctly-poisonous substances, which are insoluble in the ordinary culture-media, but which are set free after the death of the bacilli in the bodies of guinea-pigs used for experiments, and which then act as paralyzants to the centres governing the circulation and the temperature. Conclusion that, although the possibility of a successful protective inoculation against human cholera cannot be denied, the existence of such a possibility has not yet been proved experimentally. R. Pfeiffer (Zeit. f. Hygiene u. Infectionskr., Mar. 2, '94).

Inoculation by injection of serum obtained from convalescents. Freymuth (Deutsche med. Woch., Oct. 25, '94).

Solid substance obtained from residue of culture-fluid freed of micro-organisms as immunizing agent. Ransom (Deutsche med. Woch., July 18, '95).

Substances found in blood of convalescents afford inconstant immunity. Sobernheim (Hyg. Rund., p. 145, '95).

Haffkine's inoculations in India increased safety of inoculated twenty times. W. J. Simpson (Brit. Med. Jour., Sept. 21, '95).

Out of 3276 uninoculated persons, 47 cases; out of 2936 inoculated, 3 cases. Powell (Indian Med. Gaz., No. 7, '95).

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Kitasato's anticholera serum used in 193 cases. The former rate of mortality (among Japanese) has been about 70 per cent. In these cases the percentage was lowered about 20. The subsidiary results were similar to those of diphtheria antitoxin: 1. Urticaria, very common. 2. Arthralgia, observed in only 18 cases. 3. Myalgia in 6 cases. A. Nakagawa (Brit. Med. Jour., No. 1855, p. 121, '96).

Summary of all the observations in India upon Haffkine's anticholera inoculations. 1. The inoculations even in the larger doses hitherto used do not confer a complete immunity. 2. A con-

siderable degree of immunity seems to be conferred when the doses injected are sufficiently large to produce marked febrile reaction. 3. Smaller doses confer little or short-lived protection. Arthur Powell (Lancet, No. 3803, p. 169, '96).

Complete report of the results of the anticholeraic inoculations performed in Calcutta during two years. Among 654 uninoculated persons there were 71 deaths, while among the 402 inoculated individuals in the same households there were 12 deaths: a reduction of mortality of 72.47 per cent. The results in Calcutta are fully confirmed by reports from other parts of India, which are also given. Simpson (Indian Med.-Chir. Rev., July, '96).

Epidemic in 1895 in the town of Midnapore, Bengal, in which the method suggested by Hankin of disinfecting the wells by permanganate of potassium was used. It undoubtedly cut short the epidemic, statistics showing the value of the method. O'Gorman (Indian Med. Gaz., July, '96).

Referring to the researches which have shown that the protective action of the cholera serum is strictly specific, and is due to the presence of specific bactericidal substances: The serum of persons inoculated with cholera vibrios contained these substances, and not bodies antitoxic to the cholera poison belonging to the vibrios themselves. The value of inoculations emphasized in India, although the protection lasts only a year. Kolle (Deutsche med. Woch., Jan. 1, '97).

Detailed statement of results of anticholera inoculation. In Gaya jail, of 433 prisoners, 215 submitted to inoculation, after cholera had appeared in the prison. Among the inoculated there occurred 8 cases, with 3 deaths; among the unprotected, 20 cases, with 10 deaths. Haffkine (Dublin Jour. of Med. Science, Feb., '97).

The number of micro-organisms in well-water may be materially reduced for several days by placing potassium permanganate in the well. Attempt to check choleraic outbreaks in India by putting the permanganate salt in the wells of villages in which the outbreaks occurred. Enough was used to give the water a pink color until the following day, generally two or three ounces, and the procedure was repeated every third or fourth day. As a result, the cholera outbreaks were of shorter duration, and cases fewer in these villages than in those using water from wells that had not been so treated. E. H. Hankin (Brit. Med. Jour., Jan. 22, '98).

Treatment.—The treatment of cholera is still a much-vexed question, no specific remedy having been found to directly combat the infection, while serum-therapy is only yet in its incipient stage. It would be impossible to refer to the numberless methods which have been proposed and tried with variable result; I must, therefore, limit myself to the general rules which experience, a knowledge of the biology of the pathogenic microbe, and of the influence it exerts upon our system have indicated to be the most rational.

From this knowledge the aims of treatment would be as follows: 1. To restrain the development of the germs in the intestine and to neutralize the poisons to which they give rise there. 2. To counteract the poison which has penetrated into the blood-current. 3. To mitigate the effects of the twofold (local and general) action of the germs.

1. To restrain the development of the germs in the intestine and neutralize the specific toxins, no better means is at our disposal than acids, whose microbicidal properties against cholera bacilli are well shown. Therefore, internal use of acids under the form of hydrochloric, citric, or tartaric lemonade is highly to be recommended, together with the injection into the intestine, by means of a special irrigator (enteroclysma) of a warm solution of tannic acid (1 $^1/_4$ to 5 drachms for 1 $^1/_2$ to 2 quarts of water or infusion of chamomile). These injections were proposed by Cantani, who

gave the preference to tannic acid on account of its neutralizing the alkaline reaction of the intestine, corrugating blood-vessels (and so restraining the absorption of poisons), and acting as an antidote against the toxins. They must be repeated four times a day, and, in grave cases, after each alvine evacuation. The beneficial effects of this treatment I was able to observe in the cholera epidemic of 1884 in Naples, and my experience is that, if it be resorted to at the first appearance of premonitory diarrhœa, the course of the disease may be aborted, while in declared cholera many lives may be saved through its aid, when general poisoning has not yet taken place. French authors replace the hydrochloric, citric, etc., acids by the lactic lemonade, prepared with $2\,^1/_2$ drachms of lactic acid to a quart of water. On the other hand, Genersich has modified Cantani's method by injecting a larger quantity of fluid (5 to 15 quarts of a 1- to 2-per-cent. solution of tannic acid) under a greater pressure; so that the liquid may irrigate the whole intestine and be at least partly ejected by the stomach. This method, to which he gave the name of *dyaclysis*, has for its object to cause the remedial substance to act upon the whole mucous membrane of the gut; but its practical application is rendered very difficult, and it is not well borne.

Effort to cleanse the digestive tract of its pathogenic elements by the following procedure: Every patient at once made to drink as many tumblerfuls as possible of hot water, containing each 3 drops of hydrochloric acid. As soon as the patient had successively imbibed 6 or 8 tumblerfuls, manual abdominal pressure was resorted to in order to expel the liquid. Ten minutes after the vomiting had ceased the whole cleansing procedure was repeated. Sometimes a third washing was performed three hours later. Simultaneously the intestines were cleansed by means of enemata, made of from 12 to 18 tumblerfuls of a hot 2.5-per-cent. aqueous solution of tannin, or, in the absence of the drug, of the same amount of plain, hot water. The injection was usually followed by decrease of diarrhœa; but sometimes a second enema became necessary, being then administered about two hours after the first. When practicable, the measures were supplemented by a hot general bath, and a successive application of abdominal compress soaked in a hot, strong solution of kitchen-salt, and wrapping the whole body with hot sheets and blankets. Internally, the patients were given claret (boiled with cinnamon and sugar) and lemonade made of hydrochloric acid (10 drops to each tumblerful), a mouthful every ten minutes. In addition, some stimulant remedy (camphor, ether, caffeine with benzoate of sodium) was administered hypodermically. But 10 cases out of 66 thus treated lost. I. F. Shorr (Yüjno-Rüsskoia Med. Gaz., No. 13, '92).

Introduction of a soft-rubber tube one metre in length into the rectum, causing it to pass through the sigmoid flexure and enter the descending colon, and carry liquid as far, at least, as the ileo-cæcal valve. A large quantity (2 or 3 gallons) of warm soap-water thus introduced effectively cleanses the intestinal canal; the secondary effect of irrigation of the colon is to cleanse and relieve the small intestine of its contents. Of 26 cases thus treated, 23 recovered. Elmer Lee (Med. Rec., Dec. 17, '92).

Experiments carried out with a view of determining the competency of the ileo-cæcal valve, showing that in a certain number of cases success may be looked for, even though the first attempt prove a failure. In four cases there was no difficulty whatever in the passage of liquids from the anus to the stomach or even out through the mouth and nose. Judson Daland (Amer. Jour. Med. Sci., July, '93).

Choleraic patients obtain real benefit from the use of tar-water given internally, in small quantities, and in the form of enemata. It generally arrests

violent diarrhœa and vomiting, and improves the *bien-être* of the patients. Polubinski (Wratsch, No. 50, '92).

High rectal injections of an acidulated solution of peroxide of hydrogen recommended. A prolonged contact of water with turpentine transforms the former into a fairly-strong solution of peroxide of hydrogen. Shiloff (Inaug. Dis., No. 65, p. 59, '93).

For the purpose of cleansing the intestine of the specific germs, and their noxious products, the use of purgatives has been recommended, especially in the first stages of the disease; calomel and castor-oil are generally preferred, and they may sometimes give good results. But, when they do not act favorably on the first or second day, their effect can no longer be relied upon.

Attention drawn to the views held by many, viz.: the risk that attends the use of purgative medicines, and salines especially, during periods of epidemic cholera, and at places where that disease happens to be prevailing. Physicians who practice in India seem to have recognized the danger of strong purgatives. Editorial (Lancet, Sept. 23, '93).

[A large number of cases seen in which, under appropriate treatment, purging and vomiting had been stopped, and the patients apparently recovered, but who were afterward brought back to a fatal state of collapse by the administration of purgatives of an irritating nature. NEVE, Corr. Ed., Annual, '94.]

2. To counteract the effects of poisons absorbed into the blood we have no efficient means, the greater number of drugs given for this purpose (especially antiseptics) having failed or given but very imperfect results. The only thing we can do is not to exert an antidotal action upon them, but to hasten and make easy their elimination from the blood, by largely diluting it through the introduction of an artificial serum, a practice answering other important objects, as we shall see shortly.

3. Among the noxious effects of local inflammation and of the general toxæmia, which require an energetic treatment, the principal are: diarrhœa and vomiting, with excessive loss of watery fluids; and danger of heart-paralysis.

To control diarrhœa and vomiting, when excessive, is a vital indication, the profuse loss of water they involve contributing a very serious danger for the organism. Against diarrhœa, the same rectal injections of tannic-acid or acetate-of-lead solutions and internal use of opium.

Notwithstanding all modern opposition against opium, it will retain its place among the chief weapons against the disease. Tchekunoff (Ther. Gaz., Mar., '93).

[His mortality list shows 64.7 per cent., however. ED.]

Patients have already put themselves under the full influence of drugs before seeking advice. Such cases speedily succumb, largely because of a medicinal aggravation of the glandular and secretory torpor characterizing the *primæ viæ* during the course of the attack. H. Webster Jones (Lancet, Feb. 11, '93).

As a person shows the premonitory symptoms of cholera, by having one or two large watery motions passed with little or no pain, and begins to vomit, it is best to put him under the influence of opium at once. All physicians who have had much to do with the treatment of cholera in India are agreed in this; and it is noteworthy that many so-called cholera "specifics," which have from time to time been popular, contain opium in some form. F. C. Nicholson (Practitioner, Sept., '93).

Carbonate of calcium, salicylate of bismuth, etc., may also be of some service; while to subdue vomiting and painful cramps in the stomach, ice, laudanum, morphine (hypodermically), cocaine, chlorodyne, essence of mint, menthol, camphor, or chamomile may be resorted to.

Belladonna advocated. Illingworth (Med. Press and Circular, June 19, '93).

Atropine most useful on account of the control that it would exercise over the cramps of the muscles and in spasm of the bile-duct. Scriven (Brit. Med. Jour., June, '93).

Atropine of marked value in collapse. Lauder Brunton (Brit. Med. Jour., June, '93).

Shortly after the development of first symptoms a subcutaneous injection of camphor, with musk, is rapidly followed by a striking amelioration in the patient's condition, vomiting either greatly decreasing or ceasing altogether, the well-known distressing oppression about the chest similarly subsiding. Popoff (Inaug. Dis., No. 25, p. 55, '93).

Blisters to the neck, along the course of vagus, cause both vomiting and hiccough to cease. Blagovidoff (Wratsch, No. 34, '92).

Painting the region of the vagus with cantharidin collodion in four cases caused the vomiting to stop, but the hiccough was aggravated. D. Tzitrin (Wratsch, No. 34, '92).

Two doses of nitrate of silver, of $^1/_{15}$ to $^1/_8$ grain each, usually suffice to arrest the vomiting. Odartchenko (Wratsch, No. 14, '92).

A hot, strong, black-coffee infusion administered internally, 2 or 3 tumblerfuls daily, exercises a most decided beneficial action on cholera patients. Dübelïr (Wratsch, No. 42, '93).

Literature of '96 and '97.

The following treatment employed with advantage, particularly for the relief of the cramps and vomiting:—

℞ Dilute hydrochloric acid, 15 minims.
Pure pepsin essence, 20 minims.
Wine of opium, 20 minims.
Peppermint-water, 4 ounces.
Syrup of orange-flower, 1 ounce.
M. Sig.: A teaspoonful each hour.

This dose can be diminished as soon as the medicine controls the attack to some extent, so that 4 teaspoonfuls a day may be sufficient. Sometimes 15 minims of ether may be added to this mixture with advantage. Chauvin (La Méd. Mod., Sept. 5, '96).

But the effects of these remedies are only transient, and the use of some of them—especially morphine—should not be prolonged, in order to avoid the danger of increasing the general depression.

When diarrhœa and vomiting are unrestrainable, and therefore loss of water is so large as to cause a rapid thickening of the blood and drying of the tissues, an attempt must be made to restore, as much as possible, the normal composition of the blood, to render it more fluid and to make circulation and hæmatosis easier. For this purpose subcutaneous injections of a hot, saline solution were proposed by Cantani and Samuel and experimented on a very large scale and with very good effects by many physicians and by the writer. Cantani's formula is as follows: Distilled water, 1 quart; chloride of sodium, 1 drachm; carbonate of sodium, 45 grains. Of this solution, warmed to 100.4° to 104° F., one or two quarts are injected into the subcutaneous tissue of the flanks. The results of this method are most striking, sometimes even in the algid stage; and, if it does not always save life, it at least gives the patient some relief from his sufferings. Its effect is shown by removing cardiac weakness and feebleness of the pulse, by bringing on the secretion of urine, by elevation of temperature, etc.

Intravenous infusions of Hayem's artificial serum (distilled water, 1 quart; chloride of sodium, 100 grains; hydrate of sodium, 20 grains; sulphate of sodium, 1 ounce) are equally beneficial, but their use is more difficult, and they are no more prompt in their effects and not without danger. The subcutaneous injections are, therefore, generally preferable.

Case of cholera in which intravenous injections of salt solution were followed

by resuscitation sufficient to allow the patient to sit up and make a will. The operation was repeated six times, and it was noted that good effect could only be obtained when the venous system was rapidly distended. Richardson (Asclepiad, No. 4, '91).

To avoid the danger of heart-paralysis, so far as this depends upon the thickening of the blood and the emptiness of the vessels, we may have recourse to the same watery injections; but if they do not succeed, and whenever cardiac weakness is directly produced by the action of the toxins, the heart must be stimulated by hypodermic injections of sulphuric ether, camphorated oil, caffeine, strychnine, or quinine.

The value of quinine emphasized. One drachm is dissolved in 3 ounces of water by means of a sufficient quantity of dilute or aromatic sulphuric acid; of this solution a tablespoonful is administered and at once repeated if vomiting occur, and afterward at intervals of an hour and a half, until 30 grains have been taken. E. B. Fullerton (Med. Rec., Oct. 1, '92).

Quinine recommended, 1½ grains given every 2 hours for 24 hours, and repeated during a second 24 hours if necessary. If vomiting be present and beyond control, the drug should be injected beneath the skin. Huberwald (Jahrbuch für Kinderh. u. phys. Erziehung, B. 35, H. 3, '93).

Quinine, in doses of about 10 grains an hour, has given best continuous results yet obtained. Fullerton (Med. Record, July 6, '95).

Treatment adopted in 944 cases with a mortality of only 20.7 per cent. 1. (*a*) Internal administration of Botkin's anticholera drops:—

℞ Tincturæ quiniæ compositæ,
Spiritus anodyni Hoffmanni, of each, ½ ounce.
Quininæ hydrochlorici, 1 drachm.
Acidi hydrochlorici diluti, ½ drachm.
Tincturæ opii simplicis, 1 drachm.
Olei menthæ piperitæ, 10 drops.
M. Sig.: Give from 15 to 20 drops every two hours.

(*b*) Cantani's high enemata with tannic acid; (*c*) internal use of salol with subnitrate of bismuth; (*d*) calomel in small doses.

2. In severe cases stimulate and sustain the cardiac and cutaneous action: Repeated and prolonged general hot baths, heating the patient's body by any available means; free administration of wine, hot tea, or coffee with brandy; and subcutaneous injections of camphor. Sokoloff (Bolnitchnaja gazeta Botkina, Nos. 1, 2, '93).

The internal use of brandy, rum, champagne, liquor ammoniæ, inhalations of oxygen, etc., may also prove of advantage in cardiac failure.

Ammonia internally and ether hypodermically, besides the free administration of alcohol, highly recommended, the aim being to support the failing heart. Giacich (Berliner klin. Woch., Sept. 5, '92).

Hydrochlorate of ammonia recommended for the same purpose. Besides the return of heat and perspiration caused by this salt, it increases diuresis, and therefore increases the elimination of the toxic elements of the disease. Dumontpallier (Le Bull. Méd., Oct. 19, '92).

For the same purpose, and to restore the warmth of the skin, hot baths (simple or sprinkled with mustard) and the application of heat in every form (warm coverings, hot-water bottles or hot bricks around the body, Turkish baths, etc.), dry, energetic frictions, application of sinapisms, electric flagellations, etc., have proved very valuable.

The state of the bladder should be carefully watched, and if examination shows the presence of residual urine, it should be emptied through the catheter. True choleraic anuria is best combated by hot, exciting drinks, hot baths, and hypodermic injections of caffeine and pilocarpine, a solution of the latter of $^1/_5$ grain to 20 minims of distilled water being employed.

During the whole disease no food should be allowed to patients; at the most, if any food is believed necessary and the stomach is not altogether intolerant, some iced milk can be given.

The treatment of the period of reaction, when it runs a regular course, is only a hygienic one. Feeding must be carefully regulated, only liquid food being allowed the first few days, then passing gradually to more substantial nourishment. When, however, the disease assumes the typhoid form, hygienic rules must be assisted by symptomatic treatment; if adynamia supervene, cold packs and stimulants must be used; when, on the contrary, symptoms of nervous excitement prevail, lukewarm baths with cold affusions on the head, afford great relief. Cerebral congestion is best combated by the application of ice to the head, by local blood-letting, etc.

Hydrotherapy successful in curing a large number of patients already suffering from cramp in the calves, vomiting, cold extremities, and discolored stools. Friction of the skin with a piece of linen soaked in the coldest water; then a sitz-bath, at a temperature of 44.4° to 59° F. during fifteen or thirty minutes. The parts of the body not in contact with the cold water are enveloped in woolen coverings, and the abdomen is energetically rubbed. Winternitz (Blätter f. klin. Hydrotherapie, etc., Oct. 10, '92).

By rubbing the affected areas with a piece of ice, cramps—an excruciating symptom—are relieved with rapidity. Pasalsky (Provincial Med. Jour., Nov. 1, '93).

Salol is an excellent remedy against choleraic diarrhœa, provided it is administered in larger doses than are usually given; 2 to 2½ drachms during the 24 hours, 30 grains to begin with, followed every 3 hours by a dose of 15 grains. Walkowitch (La Sem. Méd., No. 56, '93).

Salol in 5-grain doses recommended, repeated hourly as long as required by the necessities of the case. The drug mitigates all choleraic symptoms. Piatnitzky (Inaug. Dis., No. 8, p. 97, '93).

Against hyperthermia and general poisoning quinine by hypodermic injections should be resorted to. Gastro-intestinal disorders (tympanites, abdominal pains, fœtid diarrhœa) must be treated by cold applications to the abdomen, by internal use of calomel, and by rectal injections of detergent and disinfecting solutions (hyposulphite of sodium 2 to 5 to 1000, boric acid and tannic acid, 5 to 10 to 1000), etc.

Fifty-one cases with but 5 deaths under immediate use of calomel, not forgetting to give hydrochloric acid at the same time. The calomel is mixed with a little water and gum powder, placing the mixture on the tongue, thus avoiding touching the teeth. The first dose is 15½ grains, repeated several times. Opium avoided. Van Hasselt (Nederlandsch Tyd. voor Genees., vol. xxxii, '93).

The administration of calomel in doses of ½ to 1 grain strongly advocated, given every hour. Treymann (Med. Press and Circular, Apr. 19, '93).

Calhoun many years ago obtained far superior results to those reported. He prescribed calomel, 10 grains; gum camphor and tannin, each 5 grains; every half-hour or hour, as the urgency of the symptoms demanded, until the diarrhœa was checked and the secretions restored to a healthy state. In combination with the above substances he occasionally prescribed opium. F. Peyre Porcher (Med. Rec., Nov. 26, '92).

Calomel most highly recommended as far back as 1855, beginning its use as soon as the choleraic diarrhœa appeared. Two or three doses of 7½ grains each are administered, followed by small doses of $^5/_6$ grain every two hours. A portion of the calomel becomes changed in the intestine to corrosive sublimate; and as corrosive-sublimate solutions have a fungus-destroying action in a strength of 1 to 30,000, it is easy to believe that the

bacilli in the intestine are directly killed by the calomel. Ziemssen (Ther. Gaz., Mar. 15, '93).

During this period, activity of the blood must be guarded against; and to this end enteroclysis with a salt solution of 10 or 15 per cent. is very useful, and, if need be, hypodermoclysis with Cantani's solution can be continued.

Cholera Nostras.

This form of cholera resembles very closely Asiatic cholera in its clinical aspects; so that the distinction between the two diseases is sometimes most difficult. Many authors, indeed, believe in their identity. Guérin, for example, claimed that cholera is always the same disease in every place, and that isolated cases, such as are met with every year in Italy, in the hot season, are identical to those which are developed in India. Leyden, also, does not think that there is a wide difference between cholera nostras and Asiatic cholera. Lastly, Talamon argues in favor of their identity, basing his theory on the fact that epidemics of choleriform diarrhœa occur from time to time without its being possible to attribute them to importation, in places where true cholera had been previously observed. This author refers to two epidemics in the neighborhood of Paris, which had been recognized as cholera nostras, but in which the bacteriological investigation had plainly shown the presence of the comma bacillus.

On the other hand, several authors hold the view that cholera nostras is a disease etiologically different from Asiatic cholera, appearing generally in sporadic cases, but sometimes becoming epidemic. It is produced very often by dietetic errors, or by the action of cold, or by the ingestion of iced draughts in persons exposed to intense heat.

Finkler and Prior found in the stools of patients affected with cholera nostras an organism in the shape of a comma bacillus, and therefore greatly resembling the cholera vibrio. It differs from the latter, however, by the fact that, when cultivated in gelatin, it very soon becomes liquefied, and does not give the cholera-red reaction. But in many cases, instead of the vibrio of Finkler and Prior, other organisms (bacillus subtilis, bacterium coli commune) have been found; so that the etiological question is still unsettled and no decided opinion can be formed about the real nature of cholera nostras.

Symptoms of cholera nostras are very like those of Asiatic cholera; very often, however, the stools are not riziform, but bilious and serous; vomiting is not common, and cooling of the skin does not reach an advanced degree. Moreover, the period of reaction is not accompanied by the serious inflammatory changes which are so common in Asiatic cholera; finally, the disease shows a more marked dependence upon seasonal influences. When cholera nostras ends in death, this takes place after the signs of collapse have grown progressively worse in persons weakened by previous illness or in children and old people. Generally the disease lasts only twenty-four to forty-eight hours; then convalescence ensues, leaving often a feeling of extreme weakness.

The treatment of cholera nostras is essentially the same as in Asiatic cholera; and prophylactic measures are of no less practical import, though the contagiousness of cholera nostras does not seem to be as great as that of Asiatic cholera. (See CHOLERA MORBUS.)

A. RUBINO,

Naples.

CHOLERA INFANTUM.

Definition.—A particularly grave form of infantile diarrhœa, with symptoms closely resembling those of true cholera; frequent persistent vomiting, copious serous dejections, high fever, and a rapidly-developing condition of profound collapse.

It is a comparatively-rare disorder, forming not more than from $^1/_2$ to 2 per cent. of all the diarrhœal cases met with during the summer months. Unfortunately for the accuracy of our statistics, the term has been applied indiscriminately to all cases of severe infantile diarrhœa. In the opinion of the best writers the name should be limited to such cases as are characterized by intense choleriform symptoms.

> [Intelligent work upon this subject is still greatly impeded by confusion in nomenclature. Many excellent articles are diminished in value or rendered actually worthless by the indiscriminate use of the terms "cholera infantum," "enteritis," and other indefinite expressions, rendering it impossible to determine the form of disease to which the author refers. The term "cholera infantum" is the one most frequently used incorrectly. It is limited by nearly every author of prominence to cases characterized by large, serous stools, accompanied by profuse vomiting, high temperature, prostration, and marked nervous symptoms. If writers for the journals would observe the same rule it would save very much confusion, and render their work of decidedly more value. HOLT and CRANDALL, Assoc. Eds., Annual, '92.]

Symptoms.—After a variable, but generally brief, period, characterized by restlessness, abdominal discomfort, and a rising temperature, the infant begins to vomit, and simultaneously or shortly afterward purging commences. The vomiting recurs frequently. At first, the contents of the stomach are ejected; then a bile-stained mucus; and, lastly, nothing but a serous fluid. The evacuations from the bowels soon assume the same serous character. They lose their fæcal appearance and acid reaction, and consist almost entirely of a colorless fluid, copious in amount, alkaline in reaction, and generally with a peculiar musty odor. Examined microscopically, little has been found in this fluid beyond a large amount of epithelial *débris*, some round cells, and numerous bacteria. Such discharges soak into the diapers, leaving almost no stain and scarcely any fæcal matter to indicate that the fluid has come from the intestines. Although these evacuations are very frequent, recurring every half-hour or hour, pain is not generally a marked feature.

The temperature taken in the rectum is always elevated, generally between 103° F. and 105° F.; nevertheless the body feels cool to the hand. Thirst is extreme; but liquids and foods of all kinds are rejected by the stomach shortly after they are taken. With such a drain upon the fluids of the body the infant rapidly loses weight and strength, and in a few hours its appearance is greatly altered. The face is of an ashy pallor, the eyes sunken, the features pinched, and the expression anxious. The open fontanelle is much depressed; the pulse is quick and weak and may be intermittent; the urine is scanty and in severe cases appears to be altogether suppressed.

During the earlier hours of the disease restlessness is a marked symptom; but, as the strength fails, this is gradually replaced by a condition of apathy, which, later on, may develop into the hydrencephaloid state: the spurious hydrocephalus of older writers. Should the disease take this course, the infant will be found lying in a semicomatose condition, with head drawn backward, pupils sluggish and sometimes unequal, abdo-

men retracted, and respiration possibly irregular and of the Cheyne-Stokes type. There may also be twitching of the arms and legs. Toward the end the infant becomes more comatose, or an attack of convulsions may supervene and usher in the close.

In some cases a condition of hyperpyrexia may precede the fatal termination. In others, the high temperature of the earlier hours may pass away and a more moderate pyrexia, or even, according to some writers, a normal or subnormal temperature take its place. Nevertheless, if the graver symptoms of collapse persist, this fall must be regarded as an unfavorable omen. In such cases we sometimes find that both vomiting and purging cease a few hours before the end occurs.

The course of this disease is very rapid, terminating in many cases in collapse and death within twenty-four or forty-eight hours after its commencement. Should hydrencephaloid symptoms set in, the end may be delayed for a day or two longer. In the few cases which go on to recovery, cessation of vomiting appears to be one of the earliest symptoms of improvement; gradually the character of the stools alters, and they become more fæcal; the restlessness abates, and improvement may be noted in the pulse and general appearance of the infant. Convalescence, however, is always tardy, and relapses are not uncommon.

Diagnosis.—The character of the onset, the persistent vomiting, the profuse serous dejections, the high temperature, and the symptoms of profound collapse rapidly developing within a few hours, form a picture unlikely to be mistaken for any other condition.

> The odor of the stools makes it possible to determine two general classes of fermentation. The fermentation of the carbohydrate foods leads to the development of acids and gases, but under no circumstances to products with a putrid odor. Proteids yield either odorless or putrid products. Fitch (Va. Med. Mthly., Mar., '94).

Etiology.—The exact nature of cholera infantum has not yet been proved, but analogy points strongly to its being a toxic condition produced by the absorption from the intestinal tract of some special toxin originating in fermenting or decomposing food. The prolonged heat of July and August appears to be a distinctly predisposing factor. Infants living under faulty hygienic conditions, and supplied either with an injudicious dietary or with milk food in the preparation of which due care has not been taken, appear to be among those most prone to attack. Although the disease may develop suddenly in the comparatively healthy, yet we find that, in the majority of cases, there has been a more or less severe antecedent disorder of the gastro-intestinal tract.

> The temperature of the soil is the key to etiology; that summer diarrhœa does not become prevalent until the temperature of the soil, at the depth of 4 feet, has risen to 56° F. The quality of the soil also should be taken into account. A porous soil is a better medium for bacterial growth and retains more moisture. Hence, towns so situated are more likely to have diarrhœal diseases prevalent. Improper food and artificial feeding are entitled to prominence as exciting causes, however. Ballard (N. Y. Med. Jour., Aug. 3, '89).
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> From 22 observations, the following conclusions are drawn: (1) the spores present in acute dyspepsia and introduced with the food will grow luxuriantly at the body-temperature, and these are capable of withstanding the action of the acids of the stomach; (2) since severe dyspepsias, especially of the cholera-infantum type, present the phenomena of acute intoxication, and increase in severity with the temperature of the atmosphere, their cause is to be sought

in the poisons generated by the saprophytic germs of the stomach and intestines; (3) some of these cases have the general characteristics of acute infectious diseases in their etiology, but the majority are not particularly endemic or epidemic, and the special characteristics of infectious diseases (stage of incubation, typical course, etc.) are rare. Seiffert (Jahrbuch f. Kinderh. u. physische Erziehung, B. 32, H. 4, '91).

A part of the failures attributed in the use of sterilized milk to changes which take place in the milk during the process of sterilizing. Milk sterilized in the usual way is not as readily digested as plain milk, and it possesses certain disadvantages which are not, however, as great as the disadvantages and dangers of milk swarming with bacteria. Partial sterilizing is sufficient in most cases. When the Arnold sterilizer is used the process should be continued but twelve or fifteen minutes, cold water being placed in the pan at first. Blackader (Montreal Med. Jour., Aug., '91).

1. When the heat rises above 165° F. the galactozymose, or starch-liquefying ferment, is destroyed. It is present in cows' milk only in minute quantities. 2. A portion of the lactalbumin is coagulated. 3. The casein, after the action of prolonged heat, is less readily coagulated by rennet, and yields slowly and imperfectly to the action of pepsin and pancreatin. 4. Fat is so affected by the heat that, after the milk has stood for some time, small lumps collect on the surface. 5. Milk-sugar is completely destroyed by prolonged heating. Leeds and Hiesland (N. Y. Med. Jour., Nov. 7, '91).

The types of gastro-intestinal disease prevalent in New York are modified by three factors: climate or season, social conditions, and food. It is not now the common belief that heat *per se* causes diarrhœa. It is only a powerful indirect factor lowering the vitality of the patient and favoring fermentative changes in milk. Crandall (N. Y. Med. Jour., Oct. 21, '93).

Literature of '96 and '97.

Careful bacterial examinations of the stools in ninety-two different cases of various degrees of intensity, and in the fatal cases similar examinations of the intestinal contents and of the various internal organs, were coupled with histological examinations with a view to determining the relation of the intestinal infections and lesions to the remoter changes in the body. Conclusion that the intestinal disorders of children are to be attributed to no one specific form of bacteria. That in many cases the actual damage is done more by the products of the bacterial growth than by the germs themselves seems clear, since we know that these products are often strongly toxic, and since in many even fatal cases no penetration of the body-tissues by the bacteria can be demonstrated. In the milder forms of these disorders it is not unlikely that the acids, which Baginsky has shown are generated by the obligatory milk-fæces bacteria in moderate quantity even under normal conditions may be the irritant of the intestinal mucous membrane chiefly responsible for the symptoms; and this conception seems fully in accord with the decided acidity of the stools in these cases. In the severer cases, and particularly when pyogenic or necrotizing species of bacteria are present, distinct inflammatory changes in the intestinal mucosa are usually present and seem often to permit the entry of the bacteria to the underlying tissues, whence they may be disseminated throughout the body and induce a general pyæmic condition of which pneumonia is not an infrequent manifestation. Booker (Johns Hopkins Hosp. Reports, vol. vi, 159, '96).

The diarrhœal disorders of childhood occurring in conjunction with elevated summer temperature appear first as functional (chemical) disturbances and subsequently as profound organic lesions of the intestinal wall. For the development of these conditions the ordinary saprophytic bacteria of the intestinal contents, and not specific bacteria, must be held responsible. The active organisms cause injury to the intestinal walls through the putrefactive processes of toxic character or through products usually non-toxic in character (ammonia and

its derivatives), inasmuch as they act as inflammatory irritants; or they cause degeneration of the vegetative and the most important excretory organs (liver, kidneys, etc.) through the blood-stream and the lymph-stream. As a result of the interference with nutrition and the diminution in the resistance of the tissues thus brought about, the organism is exposed to the invasion of pathogenic bacteria of all kinds (staphylococci, streptococci, pneumococci, oïdium albicans, etc.). There also results a predisposition to disease, as manifested by numerous complications. Baginsky (Berl. klin. Woch., Jan. 11, '97).

Study of thirteen cases leading to the following conclusions:—

1. The bacterium coli appears to be the pathogenic agent of the greater number of summer infantile diarrhœas.

2. This organism is the more often associated with the streptococcus pyogenes.

3. The virulence, more considerable than in the intestine of a healthy child, is almost always in direct relation to the condition of the child at the time the culture is taken, and does not appear to be proportional to the ulterior gravity of the case.

4. The mobility of the bacterium coli is, in general, proportional to its virulence. The jumping movement, nevertheless, does not correspond to an exalted virulence in comparison with the cases in which the mobility was very considerable without presenting these jumping movements.

5. The virulence of the bacterium coli found in the blood and other organs is identical to that of the bacterium coli taken from the intestine of the same individual. C. G. Cumston (Inter. Med. Jour., Mar., '97).

Pathology. — There are very few changes found after death either in the intestinal canal or in any of the organs. The only lesion present may often be a desquamative catarrh of the gastro-intestinal tract. In those cases which develop hydrencephalic symptoms, the appearances found after death bear no proper relation to the gravity of the symptoms. The kidneys are generally found paler than usual, with a moderate cloudy swelling of the cortex, but not to a greater extent than may be present in other febrile disorders of infancy (Holt). The earlier symptoms may, therefore, reasonably be ascribed to the influence of some toxin upon the heart, nerve-centres, and vasomotor nerves of the intestines, while many of the later symptoms must be referred to the great abstraction of serous fluid from the body.

In cholera infantum a bacillus found which was colored after the method of Gram. Cultivated in gelatin or bouillon, an alkaline product is obtained, having a distinctive odor, which it retains many months. It is more resistant to external agents than the common bacillus, and more tenacious of life. Isolated, it is capable of producing experimental cholera, like several other microbes. It probably plays an important part in the production of cholera infantum, as proved by the following reasons: 1. It exists only in cases of cholera infantum, frequently in large numbers. 2. It produces experimental cholera. 3. It produces a substance apparently identical with that produced by the comma bacillus. In doses of 4 to 5 milligrammes ($^3/_5$ to $^7/_{10}$ grain) it is toxic, and causes the death of the animal. 4. It produces choleraic intestinal lesions. Lesage (La Sem. Méd., Apr. 9, '90).

The disease is undoubtedly due to the development of a special, short, rod-shaped bacillus in the intestine, the poisoning of the subject occurring by absorption of the ptomaines produced by its growth in the intestines. Wheaton (Lancet, Aug. 12, '93).

In spite of the most careful researches, no constant micro-organism has been found, the comma bacillus not being present. At times, when cholera infantum is prevalent the temperature of the child is often considerably above normal, especially toward the end of the day. It is supposed that the high temperature indirectly induces some changes favor-

able to the rapid growth of saprophytic germs already present. Alfred H. Carter (Provincial Med. Jour., July, '93).

Prognosis.—Few diseases have a worse prognosis. The higher the rectal temperature, the younger the infant, the hotter the weather, and the more unhygienic the surroundings, the more hopeless is the case. Rotch considers the disease to be, to some extent, self-limited, and thinks that, if the infant survive the first three days, a crisis comes and the prognosis improves.

Treatment.—Regarding the disorder as a toxic condition due to the absorption of a poison from the alimentary canal, our first efforts must be directed to clearing out this tract as promptly and thoroughly as possible. For this purpose a few grains of calomel combined with sodium bicarbonate should be given in divided doses. As soon as practicable, the stomach should be thoroughly washed out with a tepid weak solution of sodium bicarbonate ($^1/_2$ drachm to the pint). Following this the whole tract of the colon should be irrigated with a saline solution (1 drachm of sodium chloride to the pint). To insure passage of the solution into the higher portions of the colon, the hips of the infant must be well elevated, and the tube passed well up into the bowel, due attention being paid to its curve. The solution should be allowed to run into the gut in a gentle steady stream from a fountain-syringe placed at a height not exceeding two or three feet. Its passage upward may be favored by a gentle massage along the course of the bowel. The temperature of the irrigating fluid (from 85° F. to 105° F.) will be determined by the condition of the patient and the degree of pyrexia.

Intestinal antisepsis and lavage advocated on account of the presence of the bacterium coli commune, which is seen in the intestines of the newborn from the first nursing, and remains throughout life in the stools of all persons, well or sick, only becoming active under certain conditions. Jules Simon (Revue Gen. de Clin. et de Thér., Nov. 16, '92).

All attempts to disinfect the intestinal canal by medicines have been disappointing. Salol and salicylates are of but little value, calomel and bismuth being the most reliable, though the latter must be given freely. Fitch (Va. Med. Mthly., Mar., '94).

The use of antiseptic solutions for irrigating is, in our opinion, not to be recommended. To be in any degree effectual they must have a moderate strength, and then there is always danger of poisonous absorption. The irrigations should be repeated during the earlier hours of the attack. In the meantime, only stimulants and ice or iced water in small quantities should be allowed by the mouth. No form of nourishment should be permitted during the first twenty-four hours. The digestive functions of the stomach and duodenum must be in complete abeyance, and any food administered will either be at once rejected by the stomach, increasing its hyperæmic condition, or, if retained, will go on to fermentation.

Literature of '96 and '97.

No food of any kind and no drugs given. Boiled water at the ordinary temperature, 3½ ounces every hour for at least twenty-four hours and hypodermic injections of 1½ to 6 drachms, according to age, every five hours, of a solution of:—

℞ Sterilized (not distilled) water, 10 ounces.
Common salt, 37 grains.
Citrate or benzoate of caffeine, 12 grains.—M.

These injections should be given slowly. In addition, warm baths (95° F.) twice or four times in the twenty-

four hours should be given, each bath lasting from five to ten minutes. Washing out the stomach and intestines, though useful in other forms of infantile diarrhœa, may give rise in choleraic diarrhœa to convulsions or collapse. In convalescence, if the diarrhœa persists, calomel or subnitrate of bismuth may be given. Not any satisfactory results obtained with salol, betol, benzonaphthol, lactic acid, tannin, or opium. Marfan (La Méd. Moderne, June 15, '97).

To counteract the depressing action of the poison, and to prevent the paretic condition of the intestinal vasomotor system, an hypodermic injection of morphine combined with atropine is probably our best remedy. Holt recommends for an infant 1 year old an initial dose of not more than $^1/_{100}$ grain of morphine and $^1/_{800}$ grain of atropine. This may be repeated in an hour, if the desired sedative action is not obtained.

[Opium is used by a majority of writers, and, when administered rationally, is an agent of the greatest value. It should not be used until decomposing matter has been removed from the alimentary canal. When the passages are small, infrequent, and of bad odor, it is decidedly contra-indicated, and it should not be pushed to narcotism in any case. It should never be combined with the ordinary diarrhœal mixtures, which are usually given at short intervals, but should be administered alone, and at intervals varying with the symptoms. Holt and Crandall, Assoc. Eds., Annual, '92.]

Beneficial effects are produced in cholera infantum by hypodermic injections of $^1/_{50}$ grain of atropine, followed by small doses of calomel and lime-water containing a little carbolic acid. Todd (Jour. de Méd., July 1, '93).

Infants bear atropine wonderfully well. Almost adult doses of atropine given to children only a few months old; for instance, $^1/_{80}$ grain of morphine and $^1/_{150}$ grain of atropine, repeated two to four times in twenty-four hours. This controls the phenomena of cholera infantum, which would terminate life perhaps in a few hours without such treatment. William Bailey (Amer. Pract. and News, July 1, '93).

Morphine, it should be remembered, is contra-indicated in condition of drowsiness or stupor. Strychnine hypodermically will also prove of some service as a cardiac and respiratory stimulant. The effect of these remedies must be watched and the injections repeated as may be necessary to secure the desired action. It is better to avoid giving powerful drugs by the mouth, as doubt must exist as to the rapidity and extent of their absorption.

Literature of '96 and '97.

In threatening cases of heart-failure strong coffee, hot or iced, recommended, according to circumstances; or the injection into the bowel through a long flexible tube of hot water with some alcohol, and 1 or more drops of tincture of opium. Jacobi (Pediatrics, July, '96).

Potassium bromide lessens or obviates the effects of the shock, and, by its action upon the vasomotor nerves, stops the transudation of serum, and thereby checks the diarrhœa and vomiting. It is a remedy of great value. Marshall L. Brown (Boston Med. and Surg. Jour., Dec. 3, '96).

For the pyrexia cool baths are demanded, and should be administered in all cases when the temperature rises over 103° F. The bath, at the outset, should have a temperature of 97° F. and should be gradually cooled by the addition of ice or iced water till a temperature of 85° is reached. The infant should remain in the bath from five to fifteen minutes, according to the effect produced; while in the bath brisk friction should be employed over the limbs and body generally. If baths are impracticable, the cold wet pack may be employed. An ice-bag or cold cloths should be kept applied to the head.

To counteract the effects of the drain of fluid from the tissues no method can compare with the injection into the cellular tissue of a sterilized saline solution (45 grains of sodium chloride to the pint of water). About $^1/_2$ pint or more of this solution may be injected at once into the subcutaneous tissue of the thigh, abdomen, or buttock; the injection may be repeated twice a day. Marked improvement in all the symptoms generally follows its employment. A suitable syringe can be easily made by attaching an hypodermic needle to the nozzle of a Davidson syringe by means of a few inches of rubber tubing.

Saline solutions or artificial serum successfully used. The physiological salt solution, which seems to be absorbed most readily, and Hayem's serum preferred. The most practical method of introducing the fluid is subcutaneously into the lumbar or gluteal regions, antiseptic precautions being observed. The fluid forms a swelling beneath the skin, the disappearance of which can be accelerated by light massage. Marois (Revue Men. des Mal. l'Enfance, Dec., '93).

Literature of '96 and '97.

In children of 6 weeks to 3 months old suffering from infantile cholera, subcutaneous injections of normal saline solution in doses of about 14 drachms, morning and evening, resorted to. After the first or second injection the frequency of the stools diminished, they began to regain their normal consistence and appearance, and in a few days the patients recovered. Loin (Sem. Méd., vol. clxxvi; Brit. Med. Jour., Nov. 20, '97).

Hydrencephaloid symptoms call for a free use of stimulants; but opium, in this condition, is better avoided.

During the course of the disease care must be given to insure all possible warmth for the extremities. Sinapisms over the stomach may be of occasional benefit. (See also Cholera Morbus and Infantile Diarrhœa.)

A. D. Blackader,
Montreal.

CHOLERA MORBUS.

Synonyms.—Cholera nostras, sporadic cholera, summer diarrhœa, choleraic diarrhœa.

Definition.—An acute affection chiefly involving the stomach and intestines and characterized by copious diarrhœa and vomiting, first of the ordinary contents and afterward of serous fluid, accompanied by abdominal pains and rapidly-increasing prostration. It was recognized and clinically described with accuracy at an early period in medical history, under the names of sporadic and endemic cholera. It frequently occurs in children and is frequently mistaken for cholera infantum *per se*, now regarded by pediatricians as a separate disorder. (See above.)

Symptoms.—Cholera morbus is liable to occur at all periods of life, though much more frequently during infancy and early childhood than during adult age. For convenience of clinical description, we may divide the cases met with at the bedside into two groups. In those belonging to the first group the patient is attacked suddenly with copious vomiting and purging, repeated at short intervals. The first discharges contain the ordinary contents of the stomach and bowels; the second are generally stained with the coloring matter of bile, while the subsequent stools consist of little else than large quantities of simple serous or "rice-water" fluid. The countenance soon becomes pale; the eyes sunken; the extremities cold and shrunken; the pulse small, frequent, and feeble; the urine scanty and sometimes suppressed. Frequent pains in the abdomen or cramps

in the muscles of the extremities cause paroxysms of great suffering. The mouth is dry and the thirst sometimes marked; the voice may be husky or feeble and the mind dull and inactive.

In the most severe cases the foregoing symptoms develop with such rapidity and severity that a fatal collapse is reached in less than twenty-four hours. In much the larger number of cases, however, after the first few hours the discharges become less frequent and profuse; the paroxysms of restlessness diminish; the pulse is less frequent, and at the end of twenty-four hours all the more active symptoms have ceased, and the secretions from the kidneys and salivary glands have returned to a more natural standard. The patient remains pale, languid, and weak for several days, during which much care is required in the regulation of diet, drink, and exercise to avoid a relapse.

In the second group of cases the symptoms commence less suddenly and are generally more persistent in duration. They quite uniformly begin with diarrhœal discharges, soon becoming copious and watery or semifluid, frothy, and sometimes very offensive, with free vomiting as often as either drinks or nourishment accumulate in the stomach. In from four to six days the patient becomes so much exhausted as to exhibit all the symptoms of approaching collapse described in cases of the first group. Except in children under two years of age, in whom there may be, as in cholera infantum, collapse and death during the first or second week of their progress, the symptoms dominate in intensity, about the end of the first week, and the vomiting ceases or recurs only when the stomach is allowed to become too full of fluids. The intestinal discharges become less frequent, smaller in quantity, and mixed with some mucus and portions of whatever had been taken for nourishment. At the same stage of progress a moderate grade of febrile reaction takes place, causing the palms of the hands and surface of the abdomen to become dry and warm; the tongue and mouth are very dry; and the patient, if a child, is more peevish and restless. The appearance and quality of the intestinal discharges vary much in different cases, being sometimes like turbid water, at other times green or light yellow with little or no odor, and in other cases semifluid and very offensive. The urine continues scanty and sometimes irritates the urethra in passing; the emaciation continues, and in many young children it becomes so extreme as to cause death from asthenia in from one to three months. But, in nearly all of the adults and many of the children, after the disease has continued from one to four weeks the discharges begin to improve both in quality and frequency, digestion and nutrition increase, and in a few weeks more the patients have regained a fair degree of health.

Differential Diagnosis.—The diseases and morbid conditions which are most likely to be mistaken for cholera morbus, both in children and adults, are epidemic cholera, and the effects of direct irritants, such as toxic doses of arsenic, poisonous mushrooms, overripe fruits, and the ptomaines occasionally in ice-cream, cheese, and canned meats, and gastro-enteric inflammation. The clinical phenomena presented by severe cases of cholera morbus and of cholera Asiatica are so nearly identical that a reliable diagnosis cannot be founded on these phenomena alone. It is true that a very large proportion of the cases of epidemic cholera commence with painless, watery diarrhœal discharges continuing from

one to three or more days, before the violent paroxysms of vomiting, purging, and cramps begin. When cholera morbus commences with diarrhœa the discharges are accompanied by more ordinary griping or abdominal pains and the early passages are more mixed with the ingesta and appearances of bile. In doubtful cases the discovery of the cholera bacillus of Koch in the intestinal discharges is claimed to be the only reliable proof that the case is one of true epidemic cholera. But there is so close a resemblance between the common bacillus of Koch and that found by Prior and Finkler in the discharges of ordinary cholera morbus as seen under the microscope, that cultures are required to complete the distinction between them. Cases of sudden and severe vomiting and purging caused by irritating ingesta are more readily distinguished from cholera morbus by their commencing very soon after the taking of bad food or poisonous substances, and by the existence of more constant burning sensations or distress at the epigastrium. The discharges also early show intermixture of mucus and sometimes streaks of blood, which, in cholera morbus, seldom appear until in the advanced stage of the disease. In gastro-enteritis the gastric and intestinal discharges are, from the beginning, less copious and are mixed with mucus; there is more epigastric distress, more febrile heat, and more frequent efforts to vomit, with the ejection of only small quantities of mucus of a green or yellow color.

In the advanced stage of some of the more severe cases of cholera morbus a condition of morbid vigilance, with rolling of the head, tossing of the hands, and moaning, supervened and sometimes ended in a general convulsion. These symptoms have generally caused the friends, and sometimes the attending physician, to think that disease was developing in the brain. I have seen a few of such cases treated with cold applications to the head and blisters behind the ears, while the real cause of the symptoms was cerebral anæmia or exhaustion.

Microscopical examinations have shown the presence of a variety of micro-organisms in the discharges of cholera morbus, but no one of them has yet proved to be of diagnostic value.

Etiology.—Abundant clinical observations and vital statistics have shown that cholera morbus, both in children and in adults, prevails most in those parts of the temperate zone characterized by a wide range of temperature between the coldest days of winter and the hottest days of summer. Its prevalence is limited almost wholly to the months of June, July, August, and September, generally commencing with the first prostrated wave of high temperature during the last week in June or the first in July and reaching its greatest prevalence by the middle of the latter month. Thus, of the 1119 deaths from cholera morbus and cholera infantum in Chicago in 1896, 1 was reported in January, 2 in April, 2 in May, 180 in June, 485 in July, 339 in August, 108 in September, 1 in October, and 1 in December. In 1895 the whole number of deaths from the same disease was 1345, of which 6 were reported in March, 3 in May, 187 in June, 554 in July, 315 in August, 275 in September, 2 in October, 2 in November, and 1 in December. So great a mortality occurring regularly during the hottest months of each year induced me to make the subject a special study during the decade following 1870. The facts gathered by such study justified the

conclusion that cholera morbus, in both adults and children, commences uniformly during the first period of high summer temperature continuing day and night not less than five days consecutively, and new cases appear during each similar hot period for sixty of ninety days. It is not simply high temperature for a single day, or for three or four days while the nights remain cool, but high temperature both day and night, four or five days in succession, that favors the development of the disease. If the air is stagnant from absence of wind, or overcrowding and narrow streets, as in populous cities, the number of attacks will be much increased. On the other hand, cities and towns so located that the nights are favored by cooler breezes from the sea suffer but little from ordinary choleraic attacks.

Nearly all the writers on general practice and on diseases of children mention high temperature and overcrowded and poorly ventilated dwellings as merely predisposing causes of the disease under consideration; while they enumerate, as direct exciting causes, the taking of improper food, as mixed salads, impure or changed milk, impure and confined air, and, in infants, the progress of dentition and the nursing of overworked, improperly fed, and unhealthy mothers or nurses.

That all these causes exist and occasionally directly excite attacks of cholera morbus in both children and adults there can be no doubt. But as they all exist in all large cities and populous districts, and at all seasons of the year, if they were the chief causes of the disease it should prevail at all seasons of the year instead of being confined to three or four of the hottest months, and it should prevail as much in cities so located as to receive cool breezes during the summer nights as in those that do not. There is probably as much lack of ventilation and as much use of poor or adulterated milk and other articles of food during the winter as during the summer. And there are quite as many overworked and badly-fed mothers, and as many infants "cutting teeth," in the month of January as in July, yet, as stated above, during the years 1895 and 1896 in Chicago only 1 death was reported from cholera morbus and infantum in January and 1039 in July. Such results show unmistakably that high temperature, continued through several consecutive days and nights, constitutes the ruling factor in the causation of the disease under consideration. The higher the temperature of the atmosphere, the less amount of oxygen is contained in each cubic foot, and consequently less reaches the air-cells of the lungs at each breath and less is distributed to the tissues of the body in a given time. Hence the nervous and muscular structures become relaxed, the watery elements of the blood escape, the perspiration carrying with it the free salts of the blood, which still further diminishes its capacity for taking up oxygen from the air-cells of the lungs. If this condition of things is continued through several successive days and nights, the capillaries of the mucous membranes of the stomach and intestines relax, and allow the serous element of the blood to escape more freely than perspiration from the cutaneous surfaces, and choleraic discharges more or less profuse are the result. If the patient is confined in a close, ill-ventilated room, as is likely to be the case with young children, especially at night, the evil effects are much increased. And close investigation shows that the beginning of a large majority of the cases

occurs during the last half of the night or early in the morning.

Since the etiological study of pathological bacteria with their ptomaines and toxins has come to engross the attention of the profession, and especially since the discovery of the epidemic cholera bacillus by Koch, many writers have suggested that cholera morbus also depended for its essential cause on a specific bacillus or its toxins. But no such organism has as yet been identified as the essential cause.

Pathology.—The essential pathological conditions involved in cases of uncomplicated cholera morbus are a morbidly sensitive condition of the mucous membrane of the alimentary canal, a general impairment of the tonicity of tissues with deficient oxygenation of the blood, and so decided an impairment of the vasomotor nervous influence over the vessels of the mucous membranes of the stomach and intestines as to allow copious exudation of the serous elements of the blood. The exudation constituting the cholera discharges results from these conditions and has no necessary connection with any grade of inflammation, catarrhal or otherwise. This is proved by the fact that, in the most rapidly fatal cases, post-mortem examinations revealed no ordinary traces of inflammation in the mucous membranes. It is only in the cases that run a more protracted course in which febrile reaction occurs, followed by more or less mucous discharges, that we find appearances of ordinary catarrhal inflammation.

Prognosis. — Cholera morbus, as it occurs in adults and in children over five years of age, runs a brief course and generally ends in recovery. Only a small percentage of such cases terminate fatally. It is very different, however, when the disease attacks infants or children under three years of age. Only a small percentage of this mortality results from the violence of the first stage and direct collapse. Much the larger part results from the occurrence of reaction and the establishment of a persistent grade enteritis and progressive exhaustion and emaciation.

Treatment.—In the beginning of attacks of active cholera morbus the leading objects to be gained by treatment are to allay the morbid sensitiveness of the mucous membrane of the alimentary canal; to restore the general tonicity of the tissues and of the vasomotor nervous system; to promote the natural secretions, especially of the liver and kidneys; and to properly regulate the diet, drinks, and general sanitary surroundings of the patient. In the treatment of all this class of patients it is of the greatest importance to secure for them a constant supply of fresh, pure air. The most complete ventilation possible and rigid cleanliness should be enforced day and night. To accomplish this is often a very difficult task among all the classes of people who occupy small or overcrowded lodging-rooms on the narrower and less-cleanly streets of our large cities. But a firm insistance upon keeping whatever doors and windows there are freely open during hot summer nights as well as during the day, and the prompt removal of all gastric and intestinal discharges from the room, will accomplish much in this direction. To overcome the morbid sensitiveness of the mucous membrane, restore the tonicity of the nervous and vascular systems, and increase natural secretions, we need the combined or coincident use of anodynes, antiseptics, and tonics. In the early stage of active vomiting and diarrhœa the following formula has been used with the most satisfactory results:—

℞ Carbolic acid, $7^1/_2$ grains.
Glycerin, 5 drachms.
Camphorated tincture of opium, 2 ounces.
Cinnamon-water, $2^1/_2$ ounces.—M.

To an adult one teaspoonful of this mixture is to be given immediately after each paroxysm of vomiting until the paroxysms cease to recur. Vomiting is never a continuous process, and if a dose of medicine is given as soon as possible after a paroxysm a few minutes will elapse before the patient can vomit, and thus some impression of the medicine is obtained. But if we follow the inclination of the patients and nurses and wait for the patient to "rest a little" and the stomach to become "settled," we simply allow time enough for the stomach to regain ability to vomit with another supply of serous exudation, and now the dose of medicine is likely to be ejected as soon as swallowed. The teaspoonful of the mixture may be given in half a tablespoonful of water; and in treating young children the dose should be apportioned to the age of the child. In addition to the above, small doses of calomel may be given every half-hour or hour until the discharges become less watery and show some indications of the presence of bile. Sinapisms of mustard may be applied over the epigastrium and to the back over the spine, but should be allowed to remain only long enough to redden the skin without vesicating it.

As soon as vomiting has ceased and the intestinal discharges show evidence of hepatic secretion, it is generally only necessary to continue the formula recommended every two, three, or four hours until the diarrhœa also has ceased and the patient is inclined to sleep. In many cases no further use of the preparation is required, rest and a judicious regulation of the diet for a few days being sufficient to restore the patient to health.

Sometimes, however, the patient's mouth remains dry, the pulse more frequent than natural, the palms of the hands and the surface of the abdomen warmer than natural, the urine scanty, and several diarrhœal discharges each day accompanied by pain and restlessness. In such cases a continuance of the carbolic-acid formula, already given, with a few drops of nitrous ether added to each dose, and giving, for nourishment only, a thin gruel or porridge made of good milk and wheat-flour, or pure milk with a little fresh lime-water added, will often insure recovery.

A very great variety of other remedies have been used with more or less benefit, nearly all of them, however, combining anodyne, antiseptic, and astringent or tonic properties with strict regulations of diet. The use of potassium bromide in the cholera morbus of infants has recently been strongly recommended by M. L. Brown. Preparations of bismuth, generally given with small doses of codeine or other anodyne, have long been used with benefit in the protracted cases. In treating cases, especially in young children, much care should be exercised in giving opiates and astringents, lest they add to the tardiness of the kidneys in secreting urine, and thereby increase the danger of coma or convulsions. (See Cholera Infantum and Infantile Diarrhœa.)

Nathan S. Davis,
Chicago.

CHOLERA NOSTRAS. See Cholera Asiatica and Cholera Morbus.

CHOLURIA.

Definition.—Choluria is a morbid condition of the urine observed in jaundice and characterized by the presence in it

of the constituents of the gall, especially the bile-pigments and the bile-acids.

In urobilinuria the normal constituents of the bile are not found in the urine, but a derivative of the bile-pigments—the urobilin—is found instead.

Symptoms.—Although the bile-acids are ordinarily present in the urine in choluria, they do not occasion characteristic symptoms, and can only be revealed by special tests. The presence of the bile is more easily detected.

The urine containing bilirubin exhibits a color varying from a light saffron-yellow to one resembling mahogany or porter; even when the color is dark brown or almost black the urine will show a tinge of olive-green or green-brown when it is seen in thin strata. The color of the urine may resemble that of a very concentrated urine or of urine containing blood; in the later cases the froth of the urine is white, while the froth of the icteric urine is yellow and tinges white a piece of linen or blotting-paper dipped into it.

On standing, icteric urine ordinarily becomes greenish, because the bilirubin, by oxidizing, changes into biliverdin; by further decomposition of the urine the pigments are further changed into biliprasin and bilifuscin.

Although cholesterin is a normal constituent of the bile, it is not found in the urine in choluria, but in other morbid conditions of the urine: *e.g.*, chyluria.

> In some cases of choluria renal casts observed in the urine without albuminuria. Nothnagel (Deut. Archiv f. klin. Med., xiii, p. 487).

Diagnosis. — Different remedies may give the urine a color resembling that observed in choluria. When santonin, thallin, rhubarb, or picric acid have been ingested, the urine and its froth will present a yellow color. In poisoning with the fruit of *Cytissus laburnum* a dark-green color of the urine is observed, whereas it is blue-green after the ingestion of methylene-blue. The presence of the bile-pigments are revealed by different tests.

1. *Gmelin's* test consists in bringing strong nitric acid containing some nitrous acid in contact with the urine; if bile be present, a play of color is developed from green to blue, violet, and finally red. These changes are due to the gradual oxidation of the bile-pigments. The green color is the most characteristic, being dependent on the formation of biliverdin. It must be remembered that in most urines a reddish tint is brought out by nitric acid, while, if much indican is present, a blue or violet color may be developed.

Gmelin's test is best performed by pouring a few cubic centimetres of nitric acid in a test-tube or a conical glass; the urine is then allowed to flow gently so as to cause it to fall on the surface of the acid. The play of color is then observed at the junction of the liquids. The urine may also be placed in the tube first and the acid poured in gradually so that it sinks down to the bottom. Only the green color is evidence for the presence of bile-pigment, since the other colors may be due to the action of the acid upon the normal urine-pigments. The presence of albumin is of no consequence; the green color is even more visible against the white albuminous deposit. Gmelin's test has been modified in different ways.

Rosenbach proposes to filter the urine through white blotting-paper and place a drop of nitric acid on the filter while still moist; or a drop of the urine and of the acid are placed separately on a white porcelain surface and allowed to come in contact. In both cases the characteristic color-rings will appear.

Gmelin's test is very reliable when the quantity of bile-pigments is not too small; when this is the case, however, it is necessary to isolate the pigment by gently shaking the urine with chloroform; this agent will dissolve the bilirubin and cause a yellow color. When the test-tube is left quiet for some minutes the chloroform solution of bilirubin will sink to the bottom, the urine can be poured out, and the test performed with the chloroform solution. Indican is not dissolved by chloroform.

Different oxidizing substances have been used instead of nitric acid.

2. *The iodine test* (Smith-Maréchal): When a few drops of tincture of iodine are added to urine containing bile-pigment an emerald-green color will appear. A watery solution of bromine will produce a similar effect.

3. *Huppert's test*: A solution of ammonia and chloride of calcium is added to the urine. When bilirubin is present a deposit of bilirubin-chalk will be formed, which is filtered and washed down in a test-tube together with strong alcohol containing sulphuric acid. When boiled the liquid takes a blue-green or emerald-green color.

4. *Jolles* recommends the following method: To 50 cubic centimetres of urine, a drop of hydrochloric acid, chloride of barium in excess, and 5 cubic centimetres of chloroform are added. The mixture is shaken and left standing for 10 minutes, then poured out and the chloroform heated in a water-bath; 3 drops of sulphuretted sulphuric acid containing one-fourth of its volume of fuming sulphuric acid are added. The characteristic rings are found at the bottom of the tube.

5. When only bilirubin is to be revealed the sulpho-diazo-benzol test of Ehrlich may be of use. The reagent and diluted acetic acid are added to the urine. When the mixture becomes dark, a few drops of glacial acetic acid will bring out the characteristic violet color.

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Modification of Ehrlich's test: Three reagents are employed: (1) a 1-per-cent. watery solution of sulphanilic acid, (2) a 1-per-cent. watery solution of nitrite of soda, and (3) pure concentrated hydrochloric acid.

In a test-tube a few drops of the first and second agents are mixed with as much urine; a drop of hydrochloric acid is added and the mixture shaken. It will then, when bilirubin, even if a very small amount is present, get dark violet. When the liquid is mixed with water the color changes into amethyst-violet. When only a very small quantity of bilirubin is present, the violet color will appear after a few minutes.

This test regarded as the most reliable and delicate of all. Krokiewicz and Batko (Wiener med. Woch., Feb. 24, '98).

The biliary pigments in the urine may decompose by standing, and then the above-mentioned tests will be without result. Bilifuscin, which is formed by decomposition of the bilirubin, is revealed by moistening white blotting-paper with the urine; the paper will assume a brown color.

Urobilin is dissolved by chloroform, and the solution takes a greenish fluorescent color upon the addition of iodine and caustic potash. Von Jaksch recommends the test of Huppert: when urobilin is present the deposit is red-brown and becomes brown or gray-brown by boiling with sulphuric acid.

Pettenkofer's test: The bile-acids are detected by means of this test, which depends on the development of a deep-purple color when these acids are acted upon by cane-sugar and strong sulphuric acid. This reaction is, however, for several reasons, most unreliable when ap-

plied to urine, and the bile-acids must be separated from the urine by a complicated method before the original Pettenkofer test can be made.

Strassburger, therefore, has modified the test in the following manner: Cane-sugar is added to the urine, and the solution is filtered through white filtering-paper. After drying the filter a drop of strong sulphuric acid is placed upon it, and after one-half minute a beautiful-red color will appear if bile-acid be present; the color finally changes into a dark purple.

> Physiological test for bile in the urine depending upon the fact that the bile-salts precipitate the peptones from solution. The precipitate produced by urine containing bile-salts in a peptone solution acidulated with acetic acid is soluble in acetic or citric acid, thus differing from all other precipitates in the urine produced by acidulated reagents. Further, the precipitate may only be partially cleared up by heat. Quantitative application of the same principle may also be made. George Oliver ("Bedside Urine-testing," '89).

Etiology and Pathology. — Choluria takes place when the constituents of the bile are absorbed by the lymphatics and pass into the blood-vessels, from where they are excreted by the kidneys. It is, therefore, a constant symptom of jaundice, and is often observed before either the skin or the mucous membranes get stained with bile-pigment. The conditions which give rise to icterus will be discussed elsewhere, but by the examination of the urine it will never be possible to discover the origin of the jaundice. In some cases the pigment contained in the urine does not seem to be due to absorption of bile in the liver, but to have been formed directly by decomposition of the blood-pigments, either while circulating in the blood (hæmatogen icterus) or after the blood has been extravasated in the tissues (Quincke's inogen icterus).

Prognosis and Treatment.—As choluria is only a symptom of absorption of bile by the blood, its prognosis is in close relation to that of the disease acting as cause. Even if the choluria is very considerable, it will quickly disappear when the obstacles for the regular flow of the bile are removed. The treatment must also be directed against the fundamental disease, while the symptom, choluria, needs no special treatment.

F. Levison,
Copenhagen.

CHORDEE. See Gonorrhœa.

CHORDITIS VOCALIS. See Laryngitis.

CHOREA.—From the Greek: χορεία.
Synonym.—St. Vitus's dance.

Some confusion arises from the fact that under the name "chorea" are included several forms of nervous disease and degeneracy having as their common and characteristic symptom jerky, arhythmic, involuntary, inco-ordinate, muscular movements, while differing widely from one another in nature, causation, pathology, prognosis, and general symptomatology. This confusion is further added to by the varying opinions held by those who write upon the subject as to what conditions shall and what shall not be included among the choreas.

The following forms are described:—

1. Sydenham's chorea. With several varieties, as "chorea insaniens," "hemichorea," etc.
2. Endemic chorea.
3. Electric chorea.
4. Hysterical chorea.
5. Saltatory spasm.
6. Oscillatory spasm.

7. Tic co-ordiné, or "habit spasm."
8. Post-hemiplegic chorea.
9. Chronic adult chorea.
10. Huntington's chorea.

Of these, the first in order is the common St. Vitus's dance, chorea minor, or acute curable chorea, and much the most common and important of the choreoid diseases. It is the form meant when the word chorea is used without qualification. Those included from the second to the seventh belong to the functional neuroses, and may be regarded as expressions of neurodegeneracy. The eighth, ninth, and tenth are attended by degenerative changes in the cortex cerebri or spinal cord, or both.

Sydenham's Chorea.

Definition.—This is the well-known "St. Vitus's dance," an acquired functional neurosis, occurring during the middle and later periods of childhood, being rarely seen before the age of five years and after puberty; it is more common in females than in males, is more frequently met with in urban than in rural populations, and during the spring months.

Symptoms.—The onset of the disease is often foreshadowed by symptoms covering a prodromal period of a few days to a few weeks. These premonitory symptoms consist in general nervousness, a tendency to fidget and uneasiness, a change in disposition; irritability and emotional weakness, headache, vague pains, some impairment of general health, and possibly the occurrence of some one of the acute diseases or unfavorable circumstances enumerated below as exciting causes of the disorder. The disease always develops gradually and with varying rapidity in different cases, the onset being marked by the appearance of the characteristic choreic movements. These are peculiar, jerky, often lightning-like, clonic spasms, involving the muscles of the face and head, neck, trunk, and extremities, usually more pronounced in the face and arms, and often more pronounced in one lateral half of the body ("hemichorea," when typically shown). The movements are sudden in onset and as suddenly cease; they are irregular in force and direction, markedly inco-ordinate, and differ in character from any other form of abnormal motor discharge known. They result in sudden grimaces and facial twitchings; sudden closure and opening of the eyes or mouth; sudden seizure and immediate dropping of any object it is attempted to grasp; twisting movements of the arms; peculiar dancing and bobbing movements of the feet, all of these movements seeming at times semipurposeful, leading to the idea on the part of the onlooker that they are due to bad habit or awkwardness, and could be prevented.

The movements vary in intensity from slight, scarcely-noticeable twitchings of co-ordinate groups of muscles, occurring at intervals, to violent and almost continuous clonic spasmodic contractions of nearly or quite all of the voluntary muscles of the body, resulting in writhings and contortions which completely incapacitate the patient and render necessary confinement to bed. The movements may occur when the muscles are at rest, but they are often precipitated or intensified by voluntary muscular effort of any kind. They are increased by efforts to prevent them and by anything which directs attention to them. They cease entirely during sleep. In many cases speech is affected in consequence of implication of labial muscles and tongue, giving rise to peculiar jerking out of words, explosive utterances, hesitation, or indistinctness of articulation which may in some cases amount to en-

tire inability to talk. The lips are occasionally bitten; the tongue rarely. The muscles of respiration may become involved, in which event there will be uneven, irregular respiratory movements, with, possibly, sighing, moaning, or other involuntary inarticulate sounds. Deglutition in severe cases is also more or less interfered with, and the patient naturally finds difficulty in feeding himself, on account of the inco-ordinate action of the muscles of the arms and hands. The urine and fæces may pass involuntarily. The gait is, in all well-marked cases, altered, and is usually shuffling and slow, the steps being unequal in length and in time, with difficulty in progressing in a straight line.

There is no rigidity nor tonic spasm. The muscles may become tender to pressure. There is usually some muscular weakness or paresis, which, in occasional cases, becomes extreme ("paralytic chorea"). The tendon-reflexes are normal. Trophic disorders are not the rule, but erythema, herpes zoster, or chloasmic blotches may be occasionally seen.

There is always some disorder, usually a general dulling of tactile temperature and muscular sense. In the early stages pain is frequent, but in later stages this gives place to well-marked analgesia. Prickling, formication, and other paræsthesiæ are common.

In uncomplicated cases the pupillary reactions are normal.

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Very acute attack of chorea in a girl of 10, in which—in addition to severe movements of the head, neck, and arms, and sometimes of the trunk and lower extremities—the ciliary muscles were affected. The pupils dilated and contracted repeatedly each minute, from the size of a pin-head until the iris was almost invisible. Sheffield (Amer. Medico-Surg. Bull., Nov. 14, '97).

Psychical abnormalities are the rule. These vary from the slight irritability, weakness, and altered disposition commonly seen in early stages to marked intellectual impairment with loss of memory, confusion of ideas, inability to concentrate attention, and grave emotional disorder of a melancholic cast. Occasionally a generalized outburst of acute insanity or delirium will occur, giving rise to the clinical subdivision "chorea insaniens."

Chorea an infectious disease. Like all other infectious diseases, its toxic principle may give rise to insanity with hallucinations, modified in form according to individual peculiarities. The onset of the insanity is, like all insanities of toxic origin, sudden, and its progress acute or subacute. Usually there is no parallelism between the choreic movements and the mental symptoms; but it is to be noted that, while chorea generally occurs in patients about 15 years of age, mental disturbance is generally found in choreic patients of 19 years of age. P. J. Möbius (Münchener med. Woch., Dec. 20, 27, '92).

A true aphasia has been noted in a few instances, usually associated with a right hemichorea.

Along with the nervous symptoms above described in detail there are, in most cases, some evidences of disorder of the general bodily functions. Fever is present at some stage, usually early, in a majority of cases. When slight and maniacal chorea is present a temperature of 103° to 104° F. is often noted. A decided rise is usual in cases showing complications, such as rheumatism, pericarditis, or endocarditis.

The renal function is, in mild uncomplicated cases, normal. In the severe cases and in almost all febrile cases albuminuria exists, and the amount of urea excreted is in excess of the normal. In maniacal chorea there is, as a rule, a distinct nephritis.

Cardiac irregularity with abnormal rapidity of action is not infrequent, and of all the complications of chorea, pericarditis and endocarditis are most often seen, the latter, especially, occurring, according to Osler, in quite one-half of all cases. Cardiac murmurs, due to the endocarditis and also in some instances to impoverished blood, are common. A true anæmia—diminution in hæmoglobin-percentage and in number of red and white corpuscles—is often noted.

In a limited number of cases symptoms of gastro-intestinal disorder occur, the symptoms being those shown in cases of autoinfection.

Since chorea occurs by preference in children of neurotic heredity, the psychical, physiological, and anatomical stigmata of degeneracy in greater or less prominence are often added to the symptoms above detailed.

Three grades of the disease are described: The mild, in which there is little disturbance of general health, no complications, and only moderately-well-marked choreic movements; the severe, in which fever, mental disorder, and other complications are present, and the inco-ordinate clonic spasms more severe and continuous, with well-pronounced muscular weakness; and the violent "chorea insaniens," characterized by rapid onset and progress, violent and continuous choreoid spasm, with fever and delirium, terminating not infrequently in death.

Diagnosis.—In typical cases no great difficulties in diagnosis are presented, the characteristic muscular movements being, in themselves, sufficient to make the nature of the case plain. In atypical forms some doubt may arise, and there are a few other states which may be confounded with acute chorea. Thus, in hysteria choreiform movements suggesting chorea may take place ("hysterical chorea"). The anæsthesia and accompanying symptoms discoverable upon examination, together with the fact that in hysteria the movements are more rhythmical than in chorea, should make a diagnosis easy.

The muscular weakness may be so extreme as to suggest acute anterior poliomyelitis. The presence of the choreic movements are, however, enough to exclude poliomyelitis. Some forms of sclerosis and degenerative changes in the cerebral cortex are attended by choreiform movements, and may, when occurring in young persons, lead to thought of acute chorea. The presence of mental disorder, exaggerated reflexes, muscular rigidity, and other spastic symptoms should prevent mistake. Friedreich's ataxia was formerly and is still sometimes mistaken for chorea by those unfamiliar with the symptomatology of nervous diseases. The scanning speech, nystagmus, and the irregular, slow, and peculiar inco-ordinate movements of Friedreich's ataxia are sufficiently different from the clinical picture of chorea to prevent confusion if a proper examination is made.

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Involuntary movement, muscular weakness, and muscular rigidity are three symptoms belonging to the group that depends on impaired functional integrity of the upper segment of the motor path. They are found in two diseases which are due, not to structural, but to functional or, perhaps, rather nutritional changes in the cortex, viz.: paralysis agitans and chorea, which have a certain kinship to one another, the former being commonly hemiplegic in its mode of commencement and extension, while the other is frequently hemiplegic in its distribution throughout its entire course. In the case of chorea the abnormal movements are so obtrusive in

comparison with the others that there is danger of the latter being overlooked, although weakness, at any rate, is now generally known as a frequent symptom. In exceptional instances weakness may be practically the only symptom, and the diagnosis may then be somewhat difficult. The age of the patient, the limitation of the weakness to one arm, and the occasional manifestation of slight choreic movements in the affected limb or in other parts may furnish the necessary clue. Monroe (Glasgow Med. Jour., Feb., '97).

A form, "alcoholic," occurring in adults with symptoms very similar to those of the ordinary form; the movements cease during sleep, although sleeplessness is a prominent symptom. The mind remains clear. Mosler (Med. Rec., Feb., '97).

Etiology and Pathology.—In general terms, choreic movements of all kinds are primarily due to inherent neuronic weakness or instability, especially in motor sphere, with abnormally-developed motor association-tracts, or to defective insulation in lines of motor discharge.

Chorea provoked by hyperexcitable state of nervous system; attacks only those who are predisposed to it. Giovanni (Le Bull. Méd., July 31, '95).

History of three families, members of which suffered from hereditary chorea. Schlesinger (Zeitsch. f. klin. Med., '92).

An affection essentially characterized by motor troubles. Heredity the only true cause of physical phenomena in chorea; are aroused, and not created, by the disease. Breton (Lancet, Nov. 17, '94).

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An unstable condition of the higher nerve-centres predisposes to the condition, and a poison affecting these centres might produce in one person epilepsy, in another general neurasthenia, and in a third chorea. Bishop (Can. Pract., Nov., '97).

The immediate exciting cause is irritation of cortical motor neurones from toxic substances in the blood due to infectious diseases, autointoxications, etc., nerve-cell fatigue, and in some cases temporarily induced abnormal "neuronic contacts" in sensorimotor sphere from sudden shock or emotion.

In the form of acute chorea under consideration the neurotic constitution with the anatomical and physiological stigma of degeneration can usually be traced. Anæmia with general bodily enfeeblement is common.

Scrofulous anæmia is an important cause. Opinion based upon 61 cases. One of the cases gave a history of syphilis, 3 of scarlet fever, 13 of organic heart disease, 7 of anæmic murmurs, 14 of rheumatism, and 29 of tuberculosis. Rachford (Cincinnati Lancet-Clinic, Dec. 17, '92).

Two new cases to support the view that pathogenic conditions of the blood are the principal factors in the disease, and that hyperinosis—mentioned by Ogle, and common in rheumatism, anæmic states, and pregnancy—is the essential condition. W. M. Donald (Physician and Surgeon, Dec., '92).

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Study of 40 cases. The blood is rarely absolutely normal in amount of coloring matter and number of red corpuscles during an attack. There is usually a moderate diminution in the hæmoglobin and a relatively slighter decrease in the number of red corpuscles; in other words, the anæmia is chlorotic in type. There is no relation between the severity of the anæmia and that of the attack, and when the latter is profound there is usually some complication competent to explain it. Anæmia is not an immediate, direct, exciting cause, but frequently a predisposing one. Burr (Pediatrics, Feb. 1, '97).

Nearly all the cases show blood-changes and leucocytosis. In a few cases marked increase in the amœboid movement of the white corpuscles observed and a possible diminution of the eosinophile or orthophiles among the white corpuscles. In all cases the condition of

the blood is of great importance in establishing a prognosis. In the further study of chorea its hæmatology is of the greatest importance, and the clinical aspects of the disease point to an infectious origin. Loudon (Clin. Med. Rec., Dec., '97).

Some cases develop without any discoverable exciting cause, but in most instances the onset of the chorea is preceded by mental strain, worry, or shock of some kind—overwork at school, fear, religious emotion, etc.—or by the occurrence of some infectious disease or toxæmic state, such as rheumatism.

Chorea is a symptom, and not a disease, the principal cause being rheumatism acting on a nervous subject. Duckworth (Brooklyn Med. Jour., May, '92).

Eighty cases of the disease, showing that the relation of chorea to rheumatism exists, although many other causes were also effective in the production of chorea. Herrington (London Lan., Jan. 12, '89).

Chorea stands in direct relation to rheumatism, and the most important argument in favor of this theory is that in some cases rheumatism ends when chorea begins, and, when the chorea disappears, comes on again. Nothnagel (Allg. Wiener med. Zeit., Nos. 44, 46, 49, 90).

Chorea very frequently occurs after acute or subacute rheumatism, but very many cases are also observed having no known connection with rheumatism in any form. William Dale (Lancet, Nov. 9, '91).

In 134 out of 196 cases of chorea rheumatism was present. In the majority of cases chorea is the result of rheumatic diathesis, although cases occur which must be considered as true neuroses. Sée (La Méd. Mod., Oct. 15, 22, '91).

Chorea is almost always of a rheumatic nature; the cases of nervous origin are rare. Simon (Le Bull. Méd., June 14, '91).

Study of the seasonal relations of chorea and rheumatism for a period of fifteen years. Chorea and rheumatism are periodical; the least severe attacks in chorea occurring in October and November and the most severe in March and April. It is the same in rheumatism. These two affections are considered to have the same casual relation with meteorological conditions. Morris Lewis (Boston Med. and Surg. Jour., June 23, '92).

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Close connection existing clinically between chorea and rheumatism. In a fatal case of chorea a considerable number of pyogenic cocci were found in the blood and in various organisms, including the brain. The same micro-organisms being discovered in the pathological products of acute articular rheumatism, it is possible that these cocci are the connecting-link in the etiology of chorea and rheumatism. Meyer (Jahrbuch f. Kinder., vol. xl, '97).

Chorea is nearly always secondary to acute articular rheumatism, or to some infectious disease. An efficient part is played by the mental emotions. In 19 of 76 cases there was no family history of disease, but an unobserved previous infection suspected. In 14 cases there were cardiac lesions, and in 6 of the 14 the chorea was unmistakably of rheumatic origin; further, there is an etiological identity between chorea and endocarditis. Marfan (Revue Mens. des Mal. de l'Enf., Aug., '97).

Chorea is nothing else but one of the numerous manifestations of rheumatism, for the following reasons: It affects the same geographic distribution; like rheumatism, it is most frequent in cold countries; it shows its preference for damp seasons; besides, if choreic patients are examined with care, it will be found that cardiac affections are frequent, even though they may not have had rheumatic antecedents. One of the arguments against a rheumatic origin is that the disease is not modified by sodium salicylate, but this same drug is equally ineffective as regards endocarditis, cutaneous eruptions, etc. Simon (Med. Press and Circular, Apr. 7, '97).

Statistics relative to the origin of chorea, which occurs only in those possessed of neurotic heredity with almost always a recent infection. This infection, in the majority of cases, is rheumatism, but there are many instances of the dis-

ease arising from other conditions, more particularly those of specific character. Legay (Thèse de Paris, '97).

Measles, whooping-cough, influenza, diphtheria, scarlet fever, endocarditis, malaria, urinary abnormalities, aggravated constipation, etc., are also important factors.

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Query whether chorea should be considered a sequel of scarlet fever or not. Cheadle recognizes it as such, but qualifies the opinion by adding that, in 1894 and 1896, 8360 cases of scarlet fever were under treatment at the Northeastern Hospital, and of these 5355 were completed there. Thirteen cases of chorea were observed, or 1 in 412 completed cases. Osler found 1 case of chorea to every 180 patients. Hence it would appear that chorea is less frequent among scarlet-fever patients than among patients in general. Of Osler's 13 cases 5 had rheumatic manifestations, which, in each instance, immediately preceded, or appeared simultaneously with, the chorea. Rheumatism or joint-affection which occurs as a complication of scarlet fever sets in toward the end of the first week; but in these cases it was considerably later, indicating a difference in the nature of the joint-affection. Priestley (Brit. Med. Jour., Sept. 25, '97).

A case of paralysis and chorea as a sequel to scarlet fever. That the scarlatinal attack bore a causative relation to the growth of the nervous condition there can be no doubt. Cornell (Medicine, Jan., '98).

Rheumatism is the most important etiological factor of chorea, the cardiac lesions being closely associated with it. Both the rheumatic diathesis and cardiac morbid conditions predispose to the disease.

Relationship between chorea, rheumatism, and heart disease: rheumatism found in 37 out of 52 cases and heart disease in a great majority. Groeddel (Wiener med. Woch., Mar. 26, '91).

Results of an analysis of 100 cases observed in relation to the connection of chorea with heart disease and rheumatism. In 28 of these one or both of the parents had had rheumatism, only those cases being counted as rheumatic in which decided symptoms had existed. Of the patients themselves, out of 100 cases, 17 had articular rheumatism and 4 rheumatic fever (21 severe cases); 9 had pains and more or less doubtful symptoms; while the remainder (70) were recorded as never having had rheumatism. In several of these cases the rheumatism immediately preceded the chorea. There was probably severe valvular lesion or endocarditis in 27 cases, and slight cardiac trouble in 16 cases. There was marked cardiac irregularity in 8 cases, of which 4 had valvular trouble and were counted among the lesions. There were, then, 47 cases in which the heart was not absolutely normal, in 27 of which, at least, there were organic lesions, and probably in many of the other cases there was some slight organic difficulty. Of the 27 cases of severe heart-trouble, 15 had chorea for the first time; in 6 cases (not seen during the first attack) the cardiac lesions were found during the second attack; in 3 cases they were found in attacks later than the second, and in 3 cases there was no record of the number of the attacks. Of the 27 cases, 8 had had rheumatism severely and 5 slightly; in 2 cases there was no record upon this point, and in 12 no rheumatism had been noticed. In many of the cases rheumatic symptoms immediately preceded or coincided with the chorea. Bullard (Boston Med. and Surg. Jour., Dec. 24, '91).

Analysis of 95 cases; 39 boys and 56 girls. In 8 cases there had been acute articular rheumatism, in 5 of which the rheumatism and chorea were closely connected in point of time. In 25 other cases there were pains, which were of too vague a character to be of importance. In 32 cases the patients had had scarlet fever, and in two cases the chorea followed scarlet fever immediately. These figures show acute articular rheumatism in less than 10 per cent. of the cases, and afford a strong argument against the cause of chorea. Knapp (Boston Med. and Surg. Jour., Dec. 24, '91).

Report of 73 cases of chorea; 51 girls and 22 boys. In only 4 cases could a history of rheumatism be distinctly traced. In all there were 12 cases of organic heart disease. In 11 of these the heart-trouble was found at the first visit, and in several it must have antedated the chorea; in the other, the heart-trouble developed after the chorea had existed for three years. Jeffries (Boston Med. and Surg. Jour., Dec. 24, '91).

Study of the relations existing between chorea, rheumatism, and diseases of the heart: 1. Neither rheumatism nor heart disease is essential to chorea. 2. The preponderance of evidence points toward the conclusion not only that rheumatism and organic heart disease conjointly appear more frequently in the choreic subject than can be accounted for by coincidence, but that the same is true of each of these affections separately. It follows, therefore, that rheumatism predisposes to chorea, and organic heart disease has the same tendency. 3. Fatal cases are generally associated with organic heart disease, and probably with organic disease of the central nervous system, notably cerebral embolism. 4. There is a large class of functional cases, mainly reflex and fostered by circumstances tending to produce functional symptoms in general. 5. The pathological connection between rheumatism and chorea, excepting in the cases where emboli are produced by accompanying endocarditis, is still obscure; probably no one theory is applicable to all cases. 6. The mechanism by which the peculiar phenomena of chorea are produced is unknown. Walton and Vickery (Amer. Jour. Med. Sci., May, '92).

Examination of 140 persons having suffered from chorea at least two years previously. In 51, heart normal; in 72, symptoms of organic lesion; in 17, cardiac disturbances. No rheumatic history in 66 per cent. Cause: an infection allied to rheumatism, but differing from it. Osler (Pacific Med. Jour., Aug., '95).

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Six cases, all in young women of ages varying from 17 to 21, in which the disease was very grave, and proved fatal in two. The previous association of scarlatina or rheumatism—articular, endocardial, and præcordial—noted in every case; likewise recurrence of chorea on the same side as the former rheumatic affection had existed. Napier (Glasgow Med. Jour., Feb., '97).

The frequency of fibrinous accretions upon the cardiac valves and the undisputed frequency of embolism of the cerebral arteries give origin to the oftenmentioned "embolic theory" of the causation of chorea, a theory first advanced by Kirkes and supported especially by Hughlings-Jackson, according to which the inco-ordinate movements of chorea are due to multiple capillary embolism of the corpus striatum. This explanation is, however, somewhat far-fetched and it is also insufficient, since there are many cases of chorea which show no evidence of embolism and in which there is no endocarditis.

A specific microbic origin has been suggested, but is, as yet, not demonstrated.

Hints at the possibility of an infectious origin for chorea. Report of a case of *chorea insaniens* in a woman of 27, who had had two attacks of rheumatism, and, with the second, had had delirium and irregular movements of the limbs. The autopsy showed an acute endocarditis, abscess of the parotid, and catarrhal pneumonia of both lungs. No special germ, however, could be discovered. Chorea is a general systematic affection, acting with greatest intensity upon the vascular system and the leptomeninges; its cause is to be sought for in a special bacillus. Berkley (Johns Hopkins Hosp. Rep., Aug., '91).

Chorea is of an infectious nature, and all other theories thus far advanced are incomplete and unsatisfactory. The infectious theory, from an anatomical stand-point, is sound, since no other lesions are found in the nervous system than those found in infectious diseases; from a clinical stand-point, since chorea is almost always preceded by premonitory symptoms of infectious diseases;

and finally, from a therapeutic standpoint, since an antiseptic substance—salol—is of undoubted efficacy in the disease. Pranese (Riforma Medica, July 21, '93).

Autopsy of a case in which microscopical examination showed a conspicuous chronic leptomeningitis involving the vertex of the brain: a proliferating process, without exudation or much cell-infiltration. In the superficial layer of the cortex there was cellular infiltration with degenerative changes. At this point a diplococcus was found. The micro-organisms were observed only in the deep layer of the pia and the superficial part of the cortex. Dana (N. Y. Med. Jour., Aug. 19, '93).

Infectious origin of chorea minor. Frequently equivalent of attack of polyarthritis or follows an attack of rheumatic fever instead of a relapse. H. Meyer (Jahrbuch f. Kinderheilk. u. phys. Erziehung, May, Aug., '95).

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Study of 600 cases. The toxin of chorea may be a glycocin, for which reason micro-organisms will not be found in the blood. No light thrown upon the connection of arthritis and chorea nor any explanation advanced why the toxin settles in the brain when chorea occurs in rheumatic subjects. Failed to find any cases of rheumatism caused by fright or any of chorea primarily induced by chill. Churton (Med. News, Dec. 4, '97).

Study of choreics bacteriologically, and discovery of a lanceolate encapsulated diplococcus extremely pathogenic to guinea-pigs, in which it determines an hæmorrhagic hyperæmia with diminished fibrin and no œdema. The histological lesions in the nervous system of patients and in the viscera of the guinea-pigs showed that the effect was more toxic than septic, with an elective action on the vessels. The findings appear to sustain Leroux's theory that chorea is a syndrome determined by some infective or toxic agent on a soil prepared by an inheritance of neurotic and arthritic tendencies. Mei (Gaz. degli Osp. et delle Clin., Aug. 22, '97).

Other suggested causes are cerebral hyperæmia, capillary thrombosis, and prolonged arterial spasm; but none of these theories offer so rational an explanation of the observed symptoms as that which attributes the choreiform movements to inherent instability in sensorimotor sphere, together with a toxæmia or a shock sufficient to disarrange the customary association- or contact-areas in cortex, basal ganglia, and cord.

In mild cases, should death occur, it is likely that no characteristic nor well-marked anatomical alterations would be detected. In severe cases there are changes in the neurone bodies of the cerebral cortex and lenticular nuclei paralleling those of fatigue, as described by Hodges and others, together with, in cases of long standing, distinct degenerative changes in nervous elements of the cortex, pyramidal tracts, and cord. When these degenerative alterations are well marked, it is likely that the clinical picture during life was that of chronic adult chorea, rather than Sydenham's chorea. In addition to the changes in the nervous elements themselves, there are, in severe and long-continued cases, secondary changes in the connective-tissue structures and blood-vessels, perivascular dilatation, accumulations of round cells in lymph-spaces, etc. In acute cases there are often small areas of softening, with congestion and capillary dilatation in cortex and lenticular nuclei. In maniacal chorea the cortex and pia mater are chiefly involved, there being usually intense hyperæmia, with evidences of acute inflammation. The changes resemble those of violent acute mania or delirium.

Report of thirty-nine autopsies. The chief changes were just beneath the cortex, where the white matter was honeycombed with little spaces, round or oval. These spaces were empty or partly filled

with blood-vessels. The process, he believes, was non-inflammatory, and was due to abnormal dilatation and filtration of the vessels' contents. The same changes were found in the basal ganglia and the internal capsule, whose fibres were split up by interlaced and dilated vessels. There was also noticed a varicosity of the nerve-fibres. In the recorded cases the most marked changes were hyperæmia, periarterial exudations, erosions, softened spots, multiple hæmorrhages, and occasionally embolisms. The changes are most marked in the deeper parts of the motor tract; but he considers chorea not as a local disease, but as a disease of the intracranial motor tract, including its starting-point in the cortex and especially in its co-ordinating adjuncts,—the lenticular nucleus and thalamus. Dana (Brain, Oct., '90).

Examination of the brains of six persons who died from chorea, with acute delirium; the lenticular nucleus showed characteristic corpuscles, usually in the anterior part of the globus pallidus in five of these. Jakowenko (Meditzinskoje Obozrenije, No. 33, '90).

The primary seat of the lesion in chorea is in the cortex, and in the chronic cases it is probably a kind of general sclerosis, somewhat resembling multiple sclerosis, although less coarse in character. Fisher (Jour. of Nervous and Mental Dis., p. 221, '90).

Examination of the brains of six patients who died from chorea; results: 1. In some cases of chorea there was a definitely-limited district of the lenticular nucleus (the globus pallidus, not the substances of roundish form, which were very resistant to coloring matters and reagents, and which were, for the most part, laid along the sides of the blood-vessels in a peculiar way). 2. These substances are in no way characteristic of chorea, for they are found to be exactly similar in the brains of beings who had never suffered from chorea. 3. These substances must be considered, in all probability, to be the calcification of an organic basis-substance, concerning the nature of which no positive opinion can be given. Wollenberg (Centralb. f. Nerv., Psych., u. gerichtl. Psychopath., Apr., '92).

Adult dog, which had been made choreic by injection of blood from another dog affected with chorea. There were found (1) generalized muscular atrophy; (2) cutaneous trophic troubles on different parts of the body; (3) rhythmic convulsions of the members, which only ceased during sleep when under the influence of strong doses of chloral; (4) lowering of the temperature. Ch. Richet and Triboulet (Bull. de la Soc. de Biol., Apr. 9, '92).

Case of hemichorea with severe hemiplegia, showing the following lesions: Atrophy of the first and second (left and right frontal) convolutions, of the ascending convolutions, and of the paracentral gyrus; atrophy due to a cerebral endarteritis resembling syphilitic endarteritis. The basilar artery presented an enormous thrombus. Fraenkel (Deutsche med. Woch., Apr. 14, '92).

Chorea is due to spinal inhibition,—a theory supported by the action of certain drugs which have the power of combating this inhibition, and especially quinine, as demonstrated by a series of experiments upon dogs affected with chorea. Wood (Boston Med. and Surg. Jour., Aug. 24, '93).

An affection of cerebral cortex. Loss of control which sensitive areas possess over motor areas. Brush (New York Med. Jour., Mar. 9, '95).

Prognosis.—The rule in chorea is a gradual and insidious onset, a slow rise in intensity and distinctness of symptoms, followed by a stationary period of weeks or several months, and a gradual subsidence of the disease, with final recovery. The malady is acute and quite curable, with a natural tendency to recovery, even when not treated at all. Some mild cases recover in a few weeks; two to three months is the duration of the typical forms, although occasionally the symptoms may persist for six or more months. Some nervousness and slight twitchings noticed when the child is

startled or excited may continue for months after recovery, and a species of chronic "habit chorea" may be the final result. A true chronic chorea rarely or never follows this variety of neurosis in children, but is occasionally seen after acute chorea in adults. In general, however, a chronic chorea in adults or in children is apt to be associated with degeneration of the cortical motor cells and pyramidal tracts, thus differing widely from the form of acute chorea under consideration. The milder forms of chorea are unattended by danger to life. Chorea insaniens is often fatal, and, where recovery from the acute affection occurs, there is danger of some permanent mental deterioration.

Mortality in chorea much higher than is generally believed. Barber (Med. and Surg. Rep., Mar. 23, '95).

Relapses after apparent recovery are not rare. The existence of a complicating rheumatism or endocarditis is thought to favor relapse.

The result in any case of chorea is largely influenced by the complications and underlying cause.

Cases exposed during acute stage to complications apt to endanger life or to bring on lasting cardiac alterations. Treigny (Arch. Cliniques de Bordeaux, Jan. 19, '95).

Treatment and Prophylaxis.—In view of the frequency with which chorea develops in intelligent and ambitious children of neurotic heredity who are overworked at school, something may be done toward preventing the development of the disease by insisting upon moderation in study and a proper observance of the rules of physical and mental hygiene.

Competition for prizes and any other excess in school-work should be forbidden, and the child encouraged to spend as much time as possible out-of-doors, in healthy games and play. Dropping back a year in classes will, by diminishing amount of intellectual effort required, often prove of decided benefit, not only for the time being, but in all after-life.

Epidemic of chorea in a girls' school, but it was not a true chorea, but rather an hysterical, rhythmical, clonic spasm associated with hemiparesis and other hysterical symptoms. Laquer (Deutsche med. Woch., Dec. 20, '88).

Three cases of arhythmic hysterical chorea in which the hysteria showed all the features of Sydenham's chorea, thus confirming the facts previously advanced by Debove, Merklen, Chantemesse, Joffroy, Séglas, Reque, and Perret. B. Ouché (Le Progrès Méd., Dec. 5, '91).

Chorea never arises in healthy children from imitation, but in all cases of so-called epidemics we have to do with an hysterical affection. In weak and poorly-nourished children chorea is often developed in the schools from overwork. Köerner (Deut. med. Woch., Apr. 2, '91).

The co-existence of chorea and hysteria admitted in a certain number of cases, but more often common chorea does not arise from hysteria, but hysteria is capable of simulating it. Dettling (Thèse de Paris, '92).

Should any indication of chorea appear, the child should be removed from school at once and placed in as good hygienic circumstances as possible. The child's attention should not be directed toward the disease, and the nervous manifestations should not be openly noticed nor commented upon by others, since self-consciousness and suggestion play an important part in exaggerating the choreic symptoms. Removal of the patient from home, relatives, and familiar surroundings will go far toward relieving the condition. A trip to the country or to the sea-shore when possible is always beneficial. Massage and hydrotherapeutic measures are almost always indicated, and do especial good in the cases in

which anæmia and general debility are present.

Hydrotherapy; wet pack best method,—sheet dipped in water at 50° to 54° F., then lightly wrung out, spread over mattress with oil-cloth; then closely wrapped around patient; latter rubbed from head to foot and placed with sheet in woolen blanket and returned to bed. Charyeux (Revue de Thér. Médico-Chir., Oct. 1, '95).

In severe cases rest in bed for a few days or even for weeks is advisable, and in the severest cases is made necessary by the violence of the contortions, which may entirely prevent the child from walking or standing. With these non-medicinal restorative measures the patient will usually recover within a month or two, but in most cases there can be little doubt that restoration is hastened by proper medicinal treatment. The drugs which experience has shown to be most useful are arsenic, strychnine, the zinc salts, silver nitrate, potassium iodide, and cimicifuga.

Most important features: rest of body and mind. Rest in bed according to severity of disease,—three weeks usually necessary. Diet: milk, soup, and eggs. Tepid baths. Arsenic best of all drugs. Charles W. Burr (Phila. Polyclinic, Aug. 3, '95).

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General health of first importance. Tonics, especially chalybeates, should be administered, and, if possible, change of air obtained. Arsenic, to be of value, must be administered in gradually-ascending doses until some toxic influence is observed. Many cases which are not relieved by internal administration are cured by arsenic hypodermically. Much benefit will be derived from offering a premium whenever the movements are controlled for a certain length of time. The most speedily beneficial results are obtained by a modified course of rest treatment. Sinkler (Amer. Jour. Med. Sci., May, '97).

Confidence in only three remedies: absolute rest, avoiding any external excitation whatever, and placing the patient in a dark room; a gentle ascending electric current along the spine, progressively increased; arsenic in large doses, commencing with 20 drops of Fowler's solution each day for children, and double this amount for adults. When the chorea ceases, the treatment should be continued for some time, as the disease readily returns. Nutrition should be carefully looked after, and gymnastics are useful. Renai (Gaz. Osp. delle Clin., Aug., '97).

Stress laid upon the attainment of "peace of mind and body." A meat diet is contra-indicated, and the patient should be out-of-doors as much as possible. Electricity useless, but warm baths valuable. In severe cases sleep may be induced by means of the wet pack; if hypnotic drugs are called for, amyl-hydrate, trional, urethan, and, in the worst cases, chloral-hydrate. In treating the general condition he states that nothing approaches arsenic for allaying the irritability of the nervous system, though nux vomica is often of service. Chorea in adults of over thirty years comes on slowly, is difficult to subdue, and its victims often develop *tædium vitæ* and suicidal impulses. In one case of this kind it was found that hyoscine acted with benefit for a time, but later on the disease progressed. Krafft-Ebing (Allg. Wien. med.-Zeit., B. 3, '97).

Attention given to bowels and diet, the securing of proper food, etc.; static electricity and inhalations of ozone also employed. Bishop (Canadian Pract., Nov., '97).

No routine treatment can be followed. The first indication is to remove everything that may be an irritating cause. The patient should be taken from school; if the prepuce is too long, it should be cut off; if there is evidence of worms they should be got rid of, etc. The percentage of hypermetropia, usually latent, he believes is extremely large, perhaps fully 70 per cent.; and an investigation for latent heterophoria should always be made with the greatest care and patience. The relief of marked heterophoria should

be finally attained only by graduated tenotomies upon the muscles exhibiting abnormal tension or by advancement of the tendons exhibiting defective power. Prismatic glasses are not curative and should not be given for constant use. Choreic subjects are usually rapidly cured by eye-treatment alone; the eye-problems encountered, however, are not, as a rule, so complicated and difficult to solve as those of epileptics. Sodium bromides employed with Fowler's solution of arsenic, and, if there is a chance of malaria being a factor in the trouble, quinine also. Tompkins (Amer. Jour. Obst., Mar., '97).

Test of arsenic and belladonna in 25 cases. Large doses of arsenic have a beneficial influence in subduing the movements, and this is best seen after they have existed for some time. The drug should be given after food, and the patient should lie down for half an hour afterward in order to avoid retching and nausea. One girl, 10 years old, received 70 grains of extract of belladonna daily: 1000 grains in twenty-six days. Another received 37 grains of atropine in eighteen days. During the administration neither fever, rash, nor erythema was noted, but the pulse became quick and the urine scanty. In 2 instances indistinctness of vision was observed; 4 suffered from sickness and diarrhœa. There was no dryness of throat, no headache, and no delirium. In 2 belladonna was useless; in the remainder its efficacy was noteworthy. It appears to be most beneficial in recent seizures, and its influence is sometimes very marked in severer forms; it makes itself felt after about four days. Should no visible improvement occur before the tenth day it is useless to continue it. It is perfectly justifiable to give to a child as much as 30 minims (Br. Ph.) of tincture of belladonna every four hours for ten days, or even longer, but certain precautions are necessary. The patient should be kept in bed and the urine measured daily; small doses of potassium acetate may be added if it becomes much diminished or if the eyelids show puffiness. In one child nocturnal incontinence occurred and the dose was lessened. As soon as the movements become trivial or occur only during exertion, it is better to omit the belladonna, to begin massage of the affected muscles, and to administer cod-liver-oil and syrup of phosphate of iron or other tonics. In obviously-rheumatic cases arsenic in large doses may be given a trial, or may be combined with belladonna from the first; it may be continued a week or longer without intermission. Overend (Lancet, July 31, '97).

Living as much as possible in the open air and gymnastic exercises recommended. Antipyrine and Boudin's solution of arsenic are the only drugs employed, and the action of the former is certain in that it shortens the duration of the disease. Boudin's solution exerts the same precise influence, only in a more pronounced manner; but it requires careful and discriminating handling, otherwise very serious mistakes may be made. Recovery does not take place until intolerance is shown by loss of appetite, vomiting, and diarrhœa; when these symptoms appear, the amount should be gradually diminished, but, after they have disappeared, the progressive doses should be repeated. Recovery usually takes place within eight or ten days, but even then the treatment must not be suspended, but the arsenic solution gradually diminished until complete suppression is reached. Grancher (Independence Méd., June 3, '97).

Mental and physical rest and maximum doses of antipyrine and arsenic recommended in the same way as suggested by Grancher. Treatment completed by the use of some hypnotic, and during convalescence gymnastics and sulphur-baths prescribed. Marfan (Revue Men. des Mal. de l'Enfance, Aug., '97).

It is always to be kept in mind that chorea is a symptom, in many instances, of some general bodily enfeeblement or disease; a thorough and searching physical examination should invariably be made.

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Attention called to the fact that headache arises oftentimes from errors of refraction and muscular insufficiency, suggesting that it is only a step farther to

admit that severe manifestations of nerve-disorder, including chorea, may be caused by the same irritation. Contention substantiated by the fact that one case that came under his own observation exhibited 3½° of right hyperphoria, and which recovered after partial tenotomy of the right superior rectus. Reyerson (Canadian Pract., Jan., '97).

Chorea is usually started by some reflex irritation, such as eye-strain, nasal irritation, tight prepuce, a bound-down clitoris, or lumbricoid worms; and secondary attacks may not always be true chorea. The patients can be divided into two classes: those that tend to get well under almost any, or even without treatment, and those who fail to obtain relief from medicine. In the latter the percentage of hypermetropia, usually latent, is extremely large, apparently about 70 per cent.; and an investigation of latent heterophoria should always be made, in choreic subjects, with the greatest care and patience. Finally, the spasmodic movements which accompany and indicate organic lesions of the brain—as, for example, those of leptomeningitis—exist in but a small proportion of choreic subjects, and are usually associated with other evidences of disease. Tompkins (Amer. Jour. Obst., Mar., '97).

Especial attention should be given the intestinal tract and stomach, renal disorder, or any state of autogenous poisoning, anæmia, malarial poisoning, the presence of intestinal parasites, etc.

Eight cases treated with quinine, 6 to 8 grains daily, and hygienic measures. In one case recovery in 1 week; in second, in 2 weeks; in third, in 10 weeks. In five cases no result; arsenic substituted. Knapp (Boston Med. and Surg. Jour., Feb. 28, '95).

Results from quinine unsatisfactory. F. B. Fry (Med. Rev., Nov. 24, '94).

But little result from quinine; faith in arsenical treatment. Many cases left to their own course recover. Putnam (Boston Med. and Surg. Jour., Feb. 28, '95).

The use of morphia, chloral, chloroform or other sedative for the suppression of the muscular movements is of questionable propriety in any case, and will usually prove injurious.

Use of hypnotics advocated, especially for the purpose of quieting the muscular unrest; paraldehyde recommended. It has no influence upon the mental disturbance, promotes sleep, quiets the muscles, and also has no bad effect upon the heart. Gerlach (Zeit. f. Psychiatrie u. gerichtl. Med., vol. xlvi, No. 5, '90).

Ten cases of chorea in which sulphonal was employed. It is indicated only as an adjuvant to arsenic, as on sulphonal alone the patients are apt to grow pale and clearly showed the need of a tonic. Jeffries (Med. News, Mar. 15, '90).

Antipyrine in large doses: 4, 8, or 15 grains, according to age, repeated 2, 3, or 5 times a day; may be continued weeks without ill effect. Comby (La France Méd. et Paris Méd., Sept. 6, '95).

Antipyrine the only medicine from which cures may be confidently expected. Initial dose should not exceed 10 or 15 grains; case should be carefully watched; dose slowly and cautiously increased. T. McCall Anderson (Brit. Med. Jour., Dec. 1, '94).

Antipyrine had a beneficial effect in 40 out of 60 cases, but in three-fifths of these cases the affection recurred. Where the drug failed the failure was due to intolerance or cutaneous eruption, but in a few cases it seemed to have no effect. It was found necessary to give large doses; doses from ½ to 1½ drachms were well tolerated for some weeks. Leroux (Revue Mens. des Mal. de l'Enfance, June, '91).

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In the second stage antipyrine appears to be the best remedy in every case, and, properly administered, is without danger, —even children bear it well,—and alike diminishes the duration of the malady and the intensity of the movements. Ten grains should be given at the outset three times a day, and gradually increased until double the amount can be ingested. During the period of decline, tonic *régime*, warm salt-baths, gymnastics, and arsenic and phosphate of lime,

alternately, are to be insisted upon. Simon (Med. Press and Circular, Apr. 7, '97).

After recovery from chorea especial care should be exercised in the education and bringing up of the child. A display of good judgment and the intelligent direction of conduct and development will be well repaid in increased stability and safety from relapse or from the subsequent occurrence of some other and more serious neurosis.

The treatment of chorea insaniens is practically the same as that of an outburst of acute mania. Active measures —eliminants and nerve-sedatives—are indicated.

Anomalous Varieties of Chorea.

The other conditions described under the name of chorea are:—

Endemic chorea, or epidemic chorea, a form of acute chorea with hysterical symptoms which develops in a number of persons at or about the same time in the same school or community. Suggestion plays an important part in its etiology.

Hysterical chorea: Closely allied to the above, but with the characteristic symptoms of hysteria superadded. The so-called "chorea major" is a purely hysterical phenomenon, and is not a chorea at all.

Electrical chorea is the name given to certain forms of acute chorea in which the movements are sudden and lightning-like in onset, and also to a state in which sudden rhythmical muscular contractions occur, simulating a *"tic co-ordiné."* The term is loosely employed, and is used in a different sense by different authors.

Procursive chorea, or "chorea festinans," is a form of chorea with hysterical accompaniments in which rhythmical dancing and procursive movements are prominent, vertigo being often present at the same time.

Saltatory spasm is a choreoid affection sometimes occurring in epidemics, and characterized by peculiar jumping and dancing movements, which are executed when the patient is startled in any way. It is closely related to the forms of muscular clonic spasm affecting a few or many groups of muscles of the body to which the name "tic convulsif" is given. It is also spoken of as "lata." It occurs in degenerates of hysterical tendencies, is often accompanied by the unconscious and involuntary repetition of words and phrases and actions seen or heard, and by the involuntary repetition of obscure words.

Oscillatory or nodding spasm, spasm nutans, is characterized by rhythmical wagging or nodding movements of the head occurring in paroxysms or continuing for hours, or even during the entire time the patient is awake. It occurs in extreme degenerates, and may be complicated with epilepsy or other neurosis, or may accompany a hemiplegia or other secondary degeneration. It shades imperceptibly into "habit chorea."

Tic co-ordiné, or habit chorea, consists in the involuntary occurrence of tricks of speech or gesture—a twist of the head, shrug of the shoulder, etc. It is sometimes a result of an early attack of acute chorea, but occurs also as a primary affection, and may be inherited.

Post-hemiplegic chorea is a name given to the irregular rhythmical or arhythmical jerky movements sometimes seen in hemiplegic limbs. Similar movements may occur as a result of infantile cerebral palsies.

Chronic adult chorea is characterized by choreic movements associated with spastic symptoms and progressive mental deterioration. There is always marked

degeneration in cortical cells and in pyramidal tracts. If there is a history of chorea in ancestry this "chronic adult chorea" is called "Huntington's" or "hereditary chorea." The affection was described fifty years ago in America, but has obtained general recognition only since Huntington called attention to it in 1872. In typical cases the disease develops insidiously, slowly progresses, and terminates in marked spastic paralysis with advanced dementia, or in death. It is closely related, in etiology, pathology, and clinical features, to general paresis, into which it probably shades by insensible degrees.

These forms of choreic movements with degenerations in brain and cord are, of course, incurable.

It will be seen that the term chorea has been applied to numerous and widely-different affections, insuring some confusion, as previously remarked. It is unfortunate that the name of "chorea" cannot be entirely restricted to mean the acute or Sydenham's chorea, since this is a tolerably-well-defined group of clinical symptoms, with a definite course and character. The other varieties of chorea are symptoms of hysteria and extreme degeneracy or of chronic degeneration in motor cells and tracts, and should preferably be relegated to their proper nosological place.

E. D. Bondurant,

Mobile.

CHOROID. See Iris, Ciliary Body, and Choroid.

CHROMIC ACID.—This is an anhydride, found as brilliant, crimson-red, acicular, deliquescent crystals that are most freely soluble in water. It is prepared by mixing a solution of potassium bichromate with sulphuric acid, rejecting the crystals of acid sulphate of potassium which crystallize out, heating the liquor, and adding more sulphuric acid, when the chromic acid is formed by crystallization. It is also soluble in ether that is free from alcohol and water. It is decomposed by most acids—lactic, sulphurous, hydrosulphuric, hydrochloric, arsenous, etc.; by glycerin; and is likely to cause explosion if mixed with the latter or with alcohol.

Preparations and Doses. — Chromic anhydride (chromic acid), external use only.

Chromic-acid liquor (1 part to 3 of distilled water), external use only.

Physiological Action.—Chromic acid possesses the power of killing all low organisms, oxidizing organic matter, coagulating albumin, and destroying the tissues with which it comes in contact. It is thus antiseptic, disinfectant, and powerfully caustic. Made into a paste with water, its action is exceedingly slow and gradual, but deeply penetrating; in saturated solution it is less penetrating and slower in action. By employing a solution more or less dilute, the action may be graduated according to the effects desired. Death has resulted from absorption when it has been applied too freely. Its local effects are, for the most part, antagonized by bland neutral fats, applied in excess. The toxic effects are similar to those of potassium bichromate, which see.

Therapeutics. — As an Antiseptic and Disinfectant.—Two drachms of chromic anhydride added to 4 or 5 quarts of water gives an inexpensive, but efficient, antiseptic and disinfecting lotion for leucorrhœas, ozænas, hyperidrosis, putrid sores, etc.; a lotion of 10 grains to the ounce has a decided effect upon syphilitic, gouty, and kindred maladies of tongue and throat. As a

local application to cancerous and other ulcerations, it is preferable to all other caustics, since the pain attendant on its application is trifling; but it must be used cautiously and discriminatingly.

Morbid Growths.—A concentrated solution is useful in removing syphilitic condylomata and warts and other morbid growths from the genital region. It has been applied to external and bleeding hæmorrhoids, to fungus hæmatodes, onychia maligna, and onychia parasitica with great benefit. Warts quickly yield to the application of chromic-acid crystals, after the surface of the growth has been slightly moistened.

Trachoma.—Some years ago a French oculist (Hairion) employed, with advantage, a solution of equal parts of acid in distilled water, applied with a camel's-hair pencil to obstinate granular ophthalmia. The applications were made at intervals of four, six, and eight days, and, although it was never very painful or followed by any great amount of reaction, it admits of great doubt how far so deeply a penetrating caustic can, with safety, be applied to so delicate an organ on the eye.

Diseases of the Air-passages.—But the greatest availability appears to be in treating diseases of the throat, upper pharynx, and nose. Owing to its hygroscopic character, no agent is so effective when applied to nasal polypi, and it is also highly recommended in hypertrophic rhinitis. In either case the most convenient method is to heat the tip of an ordinary probe and touch it to one of the acicular crystals of acid; enough adheres for two applications, but care must be taken not to overheat the instrument, lest decomposition of the chromic anhydride should occur, and an insoluble compound be formed.

CHRYSAROBIN. — This drug, also known as "Goa powder," "Araroba powder," "Po de Bahia," and also (improperly) as "chrysophanic acid," is the metamorphosed heart-wood of the *Andira araroba*: a leguminous tree indigenous to Brazil. It is a brownish-yellow crystalline powder, permanent in the air, tasteless, odorless, almost insoluble in water, slightly so in alcohol, completely in ether, containing a variable amount—70 to 80 per cent.—of chrysophan, which latter, by oxidation, is readily transformed into chrysophanic acid.

Chrysophanic acid is a neutral substance, identical with rhein, the active principal of rhubarb. It is commonly found as a granular, orange-yellow powder, but sometimes takes the form of bright, shining-yellow needles: a transformation that is effected by sublimation. Odorless, it is acrid to taste; is soluble in alkaline waters, oils, and fats, chloroform, petroleum spirit, and glycerin; but insoluble in water, alcohol, and ether.

Preparations and Doses.—Chrysarobin, $^1/_5$ to 5 grains.

Chrysophanic acid, $^1/_6$ to $^1/_2$ grain; as an emetic and purge, 8 to 20 grains.

Chrysarobin ointment (acid. chrysophanic., 1; benzoated lard, 24).

Compound chrysarobin ointment (chrysarobin, 5; salicylic acid, 2; ichthyol, 5; vaselin, 88).

Chrysarobin pigment (acid. chrysophanic., 1; solution of gutta-percha, 9).

Araroba ointment (chrysarobin, 6; glacial acetic acid, 1; lard, 14).

Bismuth chrysophanate, external use as an antiseptic only.

Zinc chrysophanate, an antiseptic dusting-powder.

Physiological Action.—In general the action of chrysarobin and chrysophanic acid, when given internally, is not un-

derstood, but Brunton and Delépine believe the latter to be an hepatic stimulant, and that it, at the same time, produces a marked increase in the glycogen of the liver. It may be added, however, that chrysarobin is an active irritant poison, and even in minute doses induces gastro-intestinal disturbances, such as vomiting and purging. There is nothing to the credit of either drug that should lead to its use as an internal remedy.

Externally, chrysarobin is an irritant to the skin, staining it yellow; and, applied in excess, produces irritation and inflammation, accompanied by swelling, itching, pain, heat, and sometimes a papular eruption; and the action is not always limited to the part to which it is applied, but extends to the healthy skin in the vicinity.

Chrysophanic acid does not cause discoloration, but it is much less active than chrysarobin, and does not, in any sense, represent the true principles of the latter.

Therapeutics. — SKIN DISEASES.— There is no doubt that chrysarobin is a remedy of value in parasitic skin diseases, and especially in psoriasis, but chrysophanic acid is far from upholding the repute of its derivative.

Literature of '96 and '97.

Chrysophanic acid does not stain like chrysarobin, and is scarcely at all irritating; but comparative experiments made with the two substances in the treatment of psoriasis lead to the conclusion that the former is not an efficient substitute for the latter in the treatment of this disease. Walter G. Smith (Brit. Jour. Derm., July, '96).

Though at various times recommended in the management of acne and eczemas, chrysarobin is seldom of value.

CHYLOCELE. See TESTICLES, DISORDERS OF.

CHYLURIA.

Definition.—A peculiar condition of the urine in which it presents a milky, or chylous, appearance and contains the constituents of chyle, especially fat and albumin.

Varieties.—Two varieties of chyluria have been observed: (1) the tropical chyluria, which is of parasitic origin; (2) the non-tropical chyluria, the cause of which is unknown.

Symptoms.—Chyluria presents an extremely-varied clinical history, and the descriptions given of cases are most diverse. Its course is marked by an irregularity and capriciousness which cannot be explained. The only constant symptom is the presence of so-called chylous urine. This fluid usually presents a peculiar whitish, opaque, milky appearance; sometimes the color is not whitish, but pink from the presence of blood. Occasionally the blood is not intimately mixed with the urine and very soon forms an adherent coagulum at the bottom of the vessel. In many cases, the urine, after some standing, will form a superficial stratum resembling cream or *blanc-mange*. The odor of the urine is ordinarily acid, rarely urinous; its reaction acid or neutral, rarely alkaline. Chylous urine ordinarily decomposes speedily and will then smell of sulphureted hydrogen. Sometimes it has been observed that chylous urine could be kept for months without fermenting. The specific gravity of the urine as well as its appearance varies greatly in the same person at different times, even at different periods of the day. The urine may, in some cases, contain coagula before evacuation, which may cause local disturbance and pain while it is being

passed. When blood-serum is added to chylous urine, large coagula will ordinarily form.

Microscopical examination of the urine shows that it contains fat in molecular form, but milk-globules or large drops of fat are not seen; the urine further contains leucocytes and blood-corpuscles, both white and red. In some cases crystals of uric acid have been observed, when the reaction of the urine is alkaline, the characteristic crystals of phosphate of ammonia—magnesia—are observed. Frerichs relates that in one case he found the urine to contain a multitude of ripe and unripe spermatozoa. In the tropical variety of chyluria, Lewis, in 1870, and after him many other investigators, found the embryos of *Filaria sanguinis* in the urine.

By shaking the urine with ether, the fat molecules are dissolved and the urine clears up, completely or partially. Besides, the ordinary fat-cholesterin and lecithin have also been found.

Chylous urine always contains albumin, generally in the form of serum-albumin; but globulin, albumose, and pepton may likewise be present. Casein has never been observed; sugar is not ordinarily contained in chylous urine, but Pavy and Habershon are said to have found it in one case.

Quantitative estimation of the contents of chylous urine have been made in great number; the amount of fat varies from 0.028 to 3.3 per cent., while the albumin was found in a quantity of 0.12 to 2.7 per cent. As may be seen, their relative proportion varies much.

The discharge of chylous urine usually occurs very suddenly; it may be constant, but more frequently is intermittent. The chyluria may cease for months and years and reappear without appreciable cause, even if the patient has made a complete change of climate. The urine is, in many cases, chylous only in the early hours of the day, or presents, at that time, a much larger quantity of chyle than at other periods of the day. This intermittence has been observed as well in the tropical as in the non-tropical varieties of chyluria. In some instances the position of the body—recumbent or erect—is found to bear influence.

Case in which chyluria occurred only in one micturition, after a fall from a height of about ten feet upon a lot of stones, from which it is probable that there occurred a rupture of a lymphatic at some point in the urinary tract. Hunt (Brit. Med. Jour., Feb. 22, '90).

Case of chyluria with complicated nervous symptoms (hysteria) the cause of which was made clear by the expulsion of a specimen of *Enstrongylus gigas* nine centimetres in length and four millimetres in diameter. Pasquale Moscato (Riforma Medica, Sept. 26, '93).

Literature of '96 and '97.

Case in a man, 57 years old, who had been in Florida for awhile. He can bring on a chyluria by lying down an hour, and more readily if he lies on the back than on the side. The *Filaria sanguinis* found by Dr. Ernst in his blood. Vickery (Boston Med. and Surg. Jour., Dec. 16, '97).

In most cases symptoms referable to the urinary organs are noticed, such as pains in the lumbar region, along the urethra, etc. Occasionally the urine coagulates in the bladder, causing pain and difficulty during micturition.

Persons suffering from chyluria may enjoy good health, but generally there is weakness, wasting, with mental depression. Tropical chyluria is often accompanied by fever and diarrhœa.

Chyluria follows a very chronic course.

Diagnosis. — Chyluria may resemble pyuria and lipuria; it can be distin-

guished from both by microscopical examination; in pyuria the urine contains innumerable pus-corpuscles; in lipuria the fat is not present in molecular form, but in large drops or in fine needles and crystals.

Etiology and Pathology.—The tropical, or parasitical, variety of chyluria is the best known, and its etiology has been elucidated by different authors. It has been observed in the United States, China, Japan, Siam, the Isle of France, Brazil, the East Indies, Egypt, Reunion, Mauritius, Australasia, and recently also in Europe in persons who never had lived in tropical regions. Tropical chyluria is caused by the presence in the blood of the embryos of *Filaria sanguinis hominis*: a nematoid worm.

These embryos were first found in the urine by Wucherer, of Bahia, and later also observed in the blood by Lewis. Their natural history has been elucidated by many observers, especially by Manson.

The adult filaria has a length of from 30 to 40 millimetres and is filiform: the embryo measures 0.0075 millimetre in diameter and 0.34 millimetre in length. Manson found that the parent filaria live in the lymphatics on the distal end of the glands; they are oviparous and their eggs are arrested in the glands and hatched there. The free embryos then pass along the lymphatic vessels and enter the circulation. Resting in some organ during the day, they circulate with the blood during the night, or, as Mackenzie has shown, they rest during the sleep of their host, whether it be night or not.

Manson describes four varieties of filaria:—

Filaria nocturna, which can be detected in the blood only at night.

Filaria diurna, which is found in the blood during the day only.

Filaria perstans, which is always present in the capillaries.

Filaria Demarquay, not half the size of the ordinary filaria.

Filariæ diurna and perstans seem to be confined to the western part of Africa, while filaria nocturna is always present in tropical countries and is endemic in some parts of the United States of America.

> Filariæ are not more frequently present in the blood than the embryo of *Bilharzia hæmatobium*. Diago (Cronica Médico-Quirûrgica de la Habana, p. 35, '90).

Literature of '96 and '97.

> Study of the blood of about sixty negroes belonging to the different tribes of the Congo States. Embryos of filaria in the blood of the majority of them found. Filaria were also found in the blood of a negro from the Congo who had been living in Belgium for six years. Firket (Annual of the Univ. Med. Sci., vol. i, D-29, '96).

It has not yet been proved in what manner the embryos of the filaria give rise to chyluria, but it is commonly believed that the parasites obstruct the lymphatics and cause their delicate walls to rupture, or that they perforate the walls of the chyliferous vessels and bring about abdominal communications.

It has already been mentioned that chyluria presents an extremely varied clinical history and may be accompanied by divers other symptoms, such as chylurious discharges from various parts of the body, with elephantiasis, lymphangiectasis, etc.

The diversity of the clinical manifestations may, perhaps, find its explanation by the fact that it is not always caused by the same species of filaria.

The non-tropical variety of chyluria is not of parasitical nature, and its origin is, as yet, quite obscure; it occurs even

in cold climates, but is a very rare disease.

Case of chyluria occurring in a woman aged 67 years. The symptoms developed during an attack of croupous pneumonia of the left lower lobe, on the ninth day of the disease. The urine resembled much the appearance of coffee weakened by a large excess of milk. No filariæ were found in the blood. Wehlau (Med. Record, Feb. 15, '90).

Case of chyluria observed in a boy of 11 years, who had never left the town of Riga, Russia. Bernsdorf (Annual, vol. i, F-43, '95).

Manson's observations seemed to show that the embryos were taken along with the blood in the stomach of a certain form of mosquito in which they undergo developmental changes. After some days the mosquito discharges its eggs in the water of some pool and the filaria there becomes free, and by this medium the animals are conveyed to the human system, through drinking the water.

Literature of '96 and '97.

Mosquitoes seem to be the active agents by which the disease is propagated. The mosquito bites a man or an animal affected with the filarial disease. The filaria curls itself around the proboscis of the mosquito, is sucked into the stomach of the insect, passes into its tissues, grows, and develops there. When the mosquito dies the worm is set free, and, getting into drinking-water, is again introduced into the human subject through the stomach and alimentary canal. Byrom Bramwell (Brit. Med. Jour., July 31, '97).

In some cases very small drops of fat have been observed to circulate with the blood and to be discharged through the kidneys; in some instances the authors favor the belief that the urine is secreted in its normal state, but that the fat is added during its passage through the ureters and the bladder.

Prognosis.—Chyluria is ordinarily a disease of long duration. Sometimes the patients recover spontaneously; in other cases it leads to anæmia and severe diarrhœa and the patient dies from exhaustion.

Treatment.—Medicine seems to have but little influence on chyluria. Rest, good nutritious diet which is not too exclusively animal, the use of pure water for drinking purposes, iron, and quinine have been recommended, as well as large doses of iodide of potassium. Against the parasitic chyluria anthelmintics have been tried, as methylene-blue (Austin Flint, Annual '96, vol. i, D-80) and thymol (Crombie, Annual, '96, vol. i, D-81). In the tropics a plant—pentaphyllum—is much relied upon; mangrove-bark is considerably used in Guiana.

Case of filarial chyluria in whom, other treatments having failed, thymol was administered in 1-grain doses every four hours, this dose afterward being doubled. Under this medication the filariæ disappeared after a few weeks from the blood, and the urine gradually improved until in about two months it had resumed its normal character. Two months later no recurrence of the pathological condition had taken place. Lawrie (Indian Med. Rec., Mar., '90).

Methylene-blue tried in a case of chyluria due to the filaria sanguinis hominis. The effects of the drug were decided and prompt. After the administration of 2 grains every four hours during the day, on March 5th, the parasites were very few at 11 P.M.; the only two found were deeply stained with blue and their movements were extremely sluggish, the urine being clear, but intensely blue. On the fourth and the seventh days no parasites were found, although the treatment had been discontinued after the first day. On the eighth day the urine became milky, and on the night of the ninth day the parasites were found in great number, but their movements were not very active. On the tenth day the treatment was resumed and continued for five days. Three days after, the

blood being examined at night, a very few motionless filariæ were observed. Since that time, and up to the present writing (more than a year), the urine has been normal and the patient has been restored to perfect health. Austin Flint (N. Y. Med. Jour., June 15, '95).

Literature of '96 and '97.

Case of chyluria, the first of the kind observed in Philadelphia. Microscopical examinations of the blood drawn from the finger showed that the parasites were very few in number or absent from the blood during the day; they were, therefore, the variety known as the *Filaria nocturna*. Methylene-blue in 2-grain capsules every three hours was ordered. After being taken continuously for seventy-two hours the blood was found to contain actively-moving unstained filariæ. The urine and fæces were stained a deep blue; the milk was uncolored. After being taken for nine days the drug proved absolutely inert so far as any influence on the vitality of the embryos was concerned, and it did not stain them until they were dead. F. P. Henry (Med. News, May 2, '96).

Two cases of chyluria in which recovery took place rapidly under the use of ichthyol in daily amounts of 7 or 8 grains, in the form of pills. Moncorvo (Nouveaux Remèdes, Dec. 8, '97).

F. Levison,
Copenhagen.

CILIARY BODY. See Iris, Ciliary Body, and Choroid.

CIMICIFUGA. — Black cohosh or black snake-root. The rhizome and rootlets of the *Cimicifuga racemosa*, a perennial plant found in the United States and Canada, contains an acrid, neutral alkaloid, soluble in water, dilute alcohol, chloroform, and ether, and two resins, one of which, cimicifugin, is precipitated from the tincture of cimicifuga when water is added to the latter.

Preparations and Dose.—It is important that all preparations of this drug be made fresh, since they deteriorate upon keeping.

Fluid extract, $^1/_2$ drachm.

Extract, 1 to 5 grains.

Tincture (20 per cent.), 1 to 2 drachms.

Cimicifugin or macrotin (resin), $^1/_2$ to 2 grains.

Physiological Action. — Cimicifuga was extensively employed by the aborigines of North America as an abortifacient, its action in this particular greatly resembling that of ergot. It may be used when the latter drug cannot be obtained as an ecbolic, not only during parturition, but in post-parturition hæmorrhage. In moderate doses cimicifuga acts as a diuretic and tends to increase the bronchial and cutaneous secretions, while in small doses it stimulates digestive functions, acting as a bitter tonic. Its influence upon the heart resembles that of digitalis; large doses increase arterial tension and cardiac action, while the pulse is slowed. The latter result being secondary, the use of the drug, when the walls of the organ are diseased, becomes dangerous in large doses.

Poisoning by Cimicifuga.—A typical case of poisoning which occurred in the person of a physician will best illustrate the effects of an excessive dose.

Dr. I. N. Brainard took 3 drachms of the fluid extract of cimicifuga, and the effects produced by the drug are by him described as follows: In about half an hour had a feeling of fullness in the head; the face was flushed; there was a sensation of warmth all over the body, with vertigo, which was increased when in the erect posture. There was considerable pain at the end of the spine. After an hour had elapsed all these symptoms were accentuated. There was redness of the eyes, but the pupils were normal, as was also the bodily temperature. The pulse was 100 and full, and

there was marked increase in the arterial tension. At no time was there any slowing of the pulse or any signs of cardiac depression. The headache now became excessively severe, and the spinal cord was apparently much stimulated. The muscles in the back, arms, and legs were hard and trembling. Two hours later these symptoms continued with increased severity, and nausea then appeared. There was increased peristalsis, but no purging. Four hours after taking the poison he drank some warm water, and vomited three times during the next five hours. The symptoms continued, nevertheless, until the eighth hour. The headache was so exceedingly severe that it was necessary for his wife to anæsthetize him with chloroform. There was a great deal of backache and restlessness. Eight hours after the drug was taken sleep came on, from which he awoke several times with marked priapism. The effects upon the spinal cord and nerves were felt for a little over two days. There was considerable increase of bronchial secretion, but no increase in the urinary flow or in the secretion of the skin was noticed during the entire period of the paroxysm.

Therapeutics.—As may be surmised from its physiological properties, cimicifuga has been recommended in almost every disease, but, being superior to very few drugs which possess special properties of a more restricted kind, it has gradually been replaced by these. Its most marked effects are probably witnessed in the treatment of acute rheumatism, and, according to Ringer, in rheumatoid arthritis. N. H. Bentley found the fluid extract valuable in rheumatic myalgia, while Balfour obtained considerable assistance for the relief of pain in disorders of neuralgic origin. Grouping the various results reported, it would seem to possess analgesic action, its diuretic properties tending, at the same time, to rid the economy of products of metabolism: the keynote of relief in rheumatic disorders.

Another disorder in which cimicifuga sometimes proves superior even to arsenic is chorea, when administered in full doses. Its action in this disease is due to its influence upon the reflex centres of the spinal cord.

As already stated, it may be substituted for ergot in obstetrical practice when the latter drug cannot be obtained, but it is not as reliable. Its influence upon the uterine circulation and the involuntary muscular fibre causes it to be very effective in cases of uterine congestion whatever be the cause. It is, therefore, frequently employed in amenorrhœa, dysmenorrhœa, delayed menstruation, the menopause, etc., when congestion of the uterus and adnexa plays an active part in the morbid process.

CINCHONA.—Cinchona, or cinchona-bark, was first brought to Europe some time in the seventeenth century, but just exactly when or how is not really known, though a great number of idle and fanciful tales are extant that purport to account for its introduction. It was certainly employed medicinally as early as 1640, though its most prominent alkaloid, quinine, was not discovered until 1820 (see QUININE).

Some thirty-six species of cinchona are recognized, and, when the number of hybrids is considered, the total is considerably augmented; but at the same time only seven constitute the source of the principle "barks" and alkaloids of commerce, as follows:—

Brown, pale, Loxa (or Loja) bark, obtained from *Cinchona officinalis* and the varieties *condaminea*, *bonplandiana*, and

crispa; red bark, from *C. succirubra*; gray, or silver, bark, from *C. nitida*, *C. micrantha*, and *C. Peruviana*; yellow bark, from *C. calisaya* and its variety *Ledgeriana*; Columbian or Cartagenia bark, from *C. lancifolia* and *C. cordifolia*; Pitayo bark, from *C. pitayensis*; and Cuprea bark from *Remijia Purdieana* and *R. pedunculata*, the last two being forms seemingly intermediate as to the true and false cinchonas. All are evergreen trees or shrubs that favor mountain-ranges and slopes at elevations varying from 400 to 11,500 feet above sea-level; they average from 30 to 80 feet in height, and measure from 1 to 2 feet in diameter at the base. The leaves resemble those of the laurel, are entire, of varying shape, the best pitted—or with numerous small shallow depressions—on the under-side (except *C. succirubra*) and a prominent mid-rib; flowers tubular, fragrant, rosy-white, or purplish; fruit-capsule two-celled, splitting from the base upward, and containing many winged seeds. All are indigenous to the Andean region of South America, and the pale, red, and yellow barks constitute the chief imports; the cuprea-barks are little used. Pale and red barks, the product of cinchona plantations in India, instituted and fostered by the government, are also obtained, arriving from Madras and other seaports on the Bay of Bengal. There are likewise plantations in Ceylon, the Malay Peninsula, in South Africa, Jamaica in the West Indies, and a very rich form of *Ledgeriana* and *calisaya* is obtained by way of Amsterdam or Hamburg from the plantations of the Dutch Government in Java. Formerly the trees were felled close to the ground and stripped of bark, not even the branches escaping, but of recent years the discovery was made that a more profitable yield could be obtained by merely removing the bark in strips or sections from the standing tree, the decorticated portion being renewed if protected, and as rich in alkaloids as before; also that the yield of alkaloids could be materially increased by covering the bark with moss or matting, thereby preventing the rays of the sun from converting the alkaloids into coloring matter. Again, it has been found that by careful selection of favorable species, and by crossing and again selecting, barks may be produced that will yield double or even treble the quantity produced by the best non-hybrid varieties.

The calisaya is one of the most important of the "barks," inasmuch as quinine constitutes from one-fourth to three-fourths of the total alkaloidal yield. The old "natural flat bark," the product of felling and stripping, is no longer met with, but, instead, so far as the United States is concerned, the major portion is a yellow bark rolled from flat pieces, coming from Bolivia; there are also "quilled" and doubly-quilled varieties, of variable thicknesses, from 3 inches to 2 feet long, $^1/_4$ to 2 $^1/_2$ inches in diameter and $^1/_{12}$ to $^1/_6$ inch thick, with a longitudinally-wrinkled and transversely-fissured, brown epidermis, the latter practically tasteless and inert, and easily separated from the inner or medicinal portion. This bark is of short, fibrous texture, compact, presenting shining points wherever broken, of brownish-yellow hue, faint odor, and bitter, slightly-astringent taste.

The red bark has many alkaloids, but does not yield as much quinine as the calisaya. It comes in quills and flat pieces, varying in thickness from $^1/_8$ to $^1/_4$ inch, is of deep-brown or brown-red color, and gives a short, fibrous fracture. The epidermis is covered with warts and ridges; the inner surface rather coarsely

striated. It gives a powder of a deep brown-red hue that is slightly odorous, but astringent and bitter.

Pale barks also come in cylindrical pieces of variable length, sometimes singly, sometimes doubly "quilled," are from $^1/_6$ to 1 inch in diameter and from $^1/_{24}$ to $^1/_6$ (more rarely $^1/_4$) in thickness. The exterior surface is rough, of a grayish color, with transverse, and sometimes longitudinal, fissures; interior surface either rough or smooth, according to the period of gathering; fracture smooth, with some short filaments on the inner surface; faintly-aromatic odor, and moderately bitter and astringent taste. Of the total alkaloids, from 50 to 65 per cent. is quinine.

Huanuco, or *gray bark*, of a cultivated variety and much richer than the pale forms in quinine, is now obtained from Jamaica. The quills are frequently somewhat spirally rolled, and on the epidermis are numerous short, irregular, transverse cracks; the edges are flat, scarcely separated or everted; the outer surface is whitish or of a clear silvery gray, or in the smaller quills of a uniform whitish-gray; inner surface yellow, yellowish-red, sometimes cinnamon-brown; smooth in small quills and fibrous in large; fracture smooth and resinous, odor clayish and pleasant; taste astringent, aromatic and bitter. The bark from *C. nitida* is not wrinkled longitudinally on the derm, and the inner portion is of a more or less brown hue; but the product of *C. micrantha* is often wrinkled longitudinally, though almost devoid of transverse fissures; it has a rusty-yellow interior. As obtained uncultivated from South America, these gray barks yield less than 3 per cent. of alkaloids, often but 1.5 per cent., of which but from $^3/_{10}$ to $^3/_5$ per cent. is quinine.

Columbian, or Cartagean, barks are of two forms. That from *C. lancifolia* is chiefly from young stems and branches, are usually "quilled" and coated with a brownish-yellow epidermis, in turn perhaps coated with white crustaceous lichens, causing it to assume a grayish or silvery appearance. The quills vary in size from $^5/_8$ to $1\,^1/_2$ inches in diameter, some being rather smooth, others rough, owing to numerous short, slight, longitudinal and transverse cracks; edges slightly everted; extremely fibrous and moderately bitter. It is not uncommon to find the "quills" *trimmed*: *i.e.*, with the epidermis removed. The interior may be reddish, orange-yellow, or yellow; hence it is not always easily distinguished from the gray barks. The *cordifolia* form occurs both as flat pieces and as fine, middling, and thick quills; the flat pieces more or less twisted, arched, and warped; from $^1/_2$ to 2 inches broad, 4 to 8 or 12 inches long, and $^1/_6$ to $^3/_4$ inch thick. The quills vary from 5 to 12 inches in length, are from $^1/_4$ to $^3/_4$ inch in diameter, and $^1/_{24}$ to $^1/_4$ inch thick, and also are frequently deprived of epidermis. The interior surface of both forms varies from smooth to fibrous, the prevailing hue being of a pale-ochre yellow, in old species brownish. The fibres often project obliquely, giving a scaly, fibrous appearance. The epidermis, when present, is observed of a whitish, yellowish-white or ash-gray hue, with irregular, flexuous, longitudinal, but not very deep furrows. The fracture, if transverse, is short, internally more or less fibrous, externally corky; longitudinally it is uneven, short, coarse, and splintery, and often effected only with difficulty. The powder is of cinnamon-hue, moderately bitter and astringent. Both the foregoing barks vary materially in their yield of alkaloids.

Petaya bark is of little interest save

to manufacturers of alkaloids, and contains from 1.5 to 1.8 per cent. of quinine. It comes in short quills or curly pieces of a brownish color, and is especially rich in quinidine.

The *cuprea barks* come in short red quills and broken pieces, and are not true cinchona-barks, but are here mentioned because they are a source of cinchona alkaloids; they contain quinine, quinidine, cinchonine, but no cinchonodine, and also cupreine: an alkaloid that exists in connection with the first named, and was formerly held to be a distinct entity to which the titles of "homoquinine" and "ultraquinine" were given.

The cinchonas are incompatible with tinctures of iodine, tannin, alkalies and alkaline carbonates; are antagonized by mercury, iodides, and the salts of lead, zinc, and copper.

Preparations and Doses.—Cinchona-bark, powdered,—all forms,—10 to 60 grains and upward.

Cinchona decoction (cinchona, 10 drachms; distilled water, 16 ounces), 1 to 2 ounces.

Cinchona infusion (cinchona, 1 ounce; water, 16 ounces), 1 to 2 ounces.

Cinchona infusion, acid (red bark, 4 drachms; boiling distilled water, 10 ounces; aromatic sulphuric acid, 1 drachm), 1 to 2 ounces.

Cinchona infusion, compound (red cinchona, 1 ounce; Virginia snake-root, 2 drachms; boiling water, 24 ounces; infuse and evaporate to 1 pint, and add 4 ounces of spirit of Mindererus), 1 to 2 ounces.

Cinchona infusion, inspissated, 30 to 60 minims (obsolete).

Cinchona extract, solid (pale and yellow forms), 5 to 30 grains.

Cinchona extract, solid (calasaya), hydro-alcoholic, 2 to 15 grains.

Cinchona extract, solid (red), 2 to 30 grains.

Cinchona extract, solid (red), alcoholic, 2 to 30 grains.

Cinchona extract, fluid (pale and yellow—5 per cent. total alkaloids), 5 to 30 minims.

Cinchona extract, fluid, aromatic, 20 to 120 minims.

Cinchona extract, fluid (red), 5 to 30 minims.

Cinchona extract, fluid (red), compound, 20 to 90 minims.

Cinchona extract, fluid (red), detannated, 20 to 90 minims.

Cinchona tincture (pale and yellow forms), 1 to 4 drachms.

Cinchona tincture (red), 30 to 120 minims.

Cinchona tincture (red), compound (Huxam's), 30 to 120 minims.

Cinchona tincture (red), compound (Whytt's), 30 to 120 minims.

Cinchona tincture, ammoniated, 30 to 120 minims.

Cinchona tincture, ferrated, 20 to 60 minims.

Cinchona-wine (cinchona tincture, 10 parts; sherry-wine and glycerin, of each, 30 parts), 1 to 4 drachms.

Cinchona-wine, aromatic, 1 to 4 drachms.

Cinchona elixir, B. P., 30 to 60 minims; U. S. P., 1 to 2 drachms.

Cinchonine crystals, 1 to 40 grains.

Cinchonine benzoate, 1 to 5 grains.

Cinchonine bisulphate, 1 to 30 grains.

Cinchonine iodosulphate, 1 to 3 grains.

Cinchonine and iron tartrate, 3 to 8 grains.

Cinchonine salicylate, 3 to 15 grains.

Cinchonine picrate, 1 to 3 grains.

Cinchonine sulphate, 2 to 30 grains.

Cinchonine tannate, 2 to 30 grains.

Cinchonidine crystals, 1 to 20 grains.

Cinchonidine bisulphate, 1 to 20 grains.

Cinchonidine borate, 1 to 10 grains.

Cinchonidine dihydrobromate, 1 to 10 grains.

Cinchonidine hydrochlorate, 2 to 20 grains.

Cinchonidine salicylate, 1 to 10 grains.

Cinchonidine sulphate, 1 to 30 grains.

Cinchonidine tannate, 5 to 15 grains.

Cinchonidine tartrate, 2 to 15 grains.

Quinetum (chinetum), 1 to 8 grains.

Quinetum sulphate, 1 to 8 grains.

Quinidine (chinidine, conchinine), 3 to 30 grains.

Quinidine bisulphate, 5 to 60 grains.

Quinidine citrate, 1 to 12 grains.

Quinidine dihydrobromate, 5 to 50 grains.

Quinidine hydrobromate, 5 to 50 grains.

Quinidine sulphate, 5 to 60 grains.

Quinidine tannate, 5 to 15 grains.

Quinoidine (chinoidine), 2 to 15 grains.

Quinoidine borate, 8 to 15 grains.

Quinoidine citrate, 5 to 25 grains.

Quinoidine hydrochlorate, 5 to 25 grains.

Quinoidine sulphate, 5 to 25 grains.

Quinoidine tannate, 5 to 15 grains.

Quinoline (true, from cinchonine), 15 to 30 minims.

Quinine, alkaloid, 2 to 15 grains (see QUININE).

Cinchona febrifuge (see QUINETUM, on pages 273 and 277).

Cupreine, 1 to 15 grains.

Cupreine sulphate, 1 to 15 grains.

Esencia de calasaya, 4 to 12 drachms.

Compound elixirs of cinchona (all kinds), 1 to 2 drachms.

Heberden's ink (aromatic iron and cinchona mixture), 1 to 2 ounces.

Homoquinine (mixture of quinine and cupreine), 1 to 15 grains.

Cinchonine and Salts.—The alkaloid appears as white shining prisms or needles, at first without much taste, but after being swallowed developing a distinct bitterness on tongue and palate; it is soluble in dilute acid, in alcohol 1 to 116, chloroform 1 to 163, and very slowly so in ether and water.

The *benzoate* is soluble in alcohol, slowly so in water, and comes in the form of small white crystals.

The *bisulphide* appears in minute trisnetric prisms, soluble in water and in alcohol.

Iodosulphate of cinchonine is a dark-brown, odorless powder containing 50 per cent. of iodine, and, though sometimes administered internally, it finds its principal use as an external application and substitute for iodoform; it is freely soluble in alcohol and chloroform; slowly soluble in water.

Nitrate of cinchonine appears as colorless prisms, soluble in water; its value is about the same as any other ordinary salt of the alkaloid.

Salicylate of cinchonine, introduced as a remedy for rheumatism, has never equaled the expectations; it comes in white crystals, soluble in alcohol.

Cinchonine sulphate is a fair substitute at times for other cinchona alkaloids; is obtained in hard, white, lustrous crystals of very bitter taste. It is soluble in 10 parts of alcohol, about 65 parts of water, and 75 to 80 of chloroform.

The *tannate* salt is of variable composition, like most tannates; it is an amorphous, yellow powder, by no means constant as to color, slowly soluble in water, and readily so in alcohol.

Cinchonidine is usually obtained from the red cinchona, and may appear either as white prisms, or a white powder, or in light, white masses, and has an intense

bitter taste; is soluble in alcohol, ether, and chloroform, in dilute acids, and in water slowly.

Cinchonidine bisulphate is soluble in water and alcohol, and comes in striated prisms. Another salt of no material value is the *borate*: a white powder that is soluble only in alcohol.

The *dihydrobromate, hydrochlorate,* and *hydroiodate* salts appear, respectively, as slightly yellowish prisms, white prisms, and yellowish-white crystals; all are soluble in water, and the hydrochlorate in alcohol and chloroform as well.

The *salicylate of cinchonidine* appears as white colorless microscopical crystals, soluble in alcohol, very slowly so in water.

Cinchonidine sulphate presents white, silky, acicular crystals that effloresce on exposure; is soluble in alcohol and hot water; slowly so in cold water.

The *tannate* is a yellow, amorphous powder, practically tasteless, of uncertain and variable composition.

Cinchonine tartrate, very slowly soluble in water, rapidly so in alcohol, is a white crystal powder.

Quinetum, known also as chinetum, kinetum, and cinchona febrifuge, is a mixture of the alkaloids of red cinchona-bark, devised by East Indian authorities as a better, cheaper, and safer remedy than quinine, and it seems to have met with general favor. In the United States is prepared an elixir of all the cinchona alkaloids that is most palatable, known as "esencia de calasaya," which is intended for the same precise purpose. Quinetum is an amorphous, grayish-white powder, containing from 50 to 70 per cent. of cinchonidine; is soluble in dilute acids and slowly so in water. *Quionin* purports to be much the same thing, but is more uncertain as to composition. There is also a neutral *sulphate* of quinetum prepared.

Quinidine, chinidine, or conchinine, has the form of colorless, lustreless prisms, and effloresces on exposure; is soluble, 1 to 20, in alcohol, 1 to 30 in ether, and 1 to 2000 in water. Both a *sulphate* and *bisulphate* are had, the former as white needles, the latter as long, colorless crystals, both being extremely bitter; the sulphate is soluble, 1 to 8, in alcohol, 1 to 14 in chloroform, 1 to 100 in water, while the bisulphate is soluble (with fluorescence) in water only.

The *dihydrobromate, hydrobromate,* and *hydrochlorate* are all white crystal salts, all soluble in water, and the last two also in alcohol.

The *tannate* is an amorphous, tasteless, white powder only partly soluble in alcohol.

Quinoidine, or chinoidine, is a mixture of amorphous alkaloids that remain in solution after the crystalline alkaloids have been separated. It is a very bitter, brownish-black mass, lustrous and resinous in appearance, soluble in dilute acids, alcohol, and chloroform, and softens at a temperature of 212° or less. The *borate* and *citrate* appear as yellowish-brown and reddish-brown scales, respectively, and both are soluble in water and alcohol. The *hydrochlorate* and *sulphate* are bitter white powders, alike soluble in alcohol and water. The *tannate* is a yellow or brownish amorphous powder partly soluble in alcohol.

Quinoline, for the most part, is a tertiary amine derived synthetically from aniline, or naturally from coal-tar, though it can also be had from cinchonine. It is a colorless liquid of peculiar odor, that turns yellow with age, and is lauded as an antiseptic; a large number of salts are made, but these are not de-

rived from the cinchonine product, which is five times as expensive as the synthetic or that had from coal-tar.

For description of the quinine alkaloids see QUININE.

Quinic, or *kinic, acid* is another derivative of the cinchona-barks, with a decided acid taste, soluble in water and alcohol, and obtained in the form of hard, white, transparent, monoclinic prisms.

Quinolinic acid is no longer had from cinchonine, but from the artificial product; and the same is true of the quinosulphuric acids.

Quinopicric acid is a yellowish-brown powder made by mixing quinine and cinchonine picrates.

Quinovic acid is secured from quinovin, derived from certain cinchonas. These two, quinidamine, quinquinia, quinicine, quinone, and quinotannic acid are obsolete, reclassified, and rearranged, or no longer obtained from cinchona-barks or alkaloids, but as the result of chemical enterprise in connection with aniline and the coal-tar products.

Physiological Action. — The physiological effects of the cinchona-barks and their alkaloids are so inextricably bound up with the action of quinine that they cannot well be separated; therefore only a brief *resumé* can be here given; for more elaborate description, the reader is referred to QUININE.

Cinchona is about fifty times more bulky than its alkaloids, is more astringent, more apt to irritate the stomach, and much more difficult of absorption. Given in sufficient doses, cinchona and its alkaloids are antiperiodic, tonic, febrifuge, and to some degree antiseptic. In small doses no sensible effect is produced, except, perhaps, with the exception of slight arterial excitement, though some, who may be particularly sensitive to the drug, may exhibit an increased flow of animal spirits. Taken in medium doses, just before retiring at night, they sometimes induce sleeplessness. In large or long-continued doses headache may be induced, along with deafness, noises or ringing in the ears, flashings of light across the eyes, vertigo, nausea, and even delirium and coma if pushed to extremes. The supervention of any of these symptoms, called "cinchonism," indicates that the full physiological effects have been produced, and that no further benefit can be obtained by persevering in administration. The action is much more rapid and energetic when given on an empty stomach, especially after considerable abstinence from food, or when combined with an acid, than when given after meals or in merely a semisoluble state. The drugs, moreover, appear to be—at least in considerable proportion—taken up by the circulation with the result of depriving the blood to greater or less extent of its coagulability; in fact, when the dose is sufficiently large the action is like that of any other poisonous agent. No doubt, the reflex excitability of the cord is diminished on occasions, though this has, in many instances, been denied. Small doses tend to increase the secretion, while large produce a diametrically-opposite effect. Respiration appears not to be influenced. Large doses exhibited during a febrile paroxysm materially depress temperature. The alkaloidal salts may be detected in considerable quantities in the urine in from 30 to 60 minutes after ingestion, but where the bark is exhibited transformation and elimination may be materially delayed. Elimination is usually at its height, in any event, during the third hour; diminishes in twenty-four hours; and ceases about the third day. Although

traces of salts may be found in the saliva, perspiration, and the secretions and excretions of the intestines, the bulk of elimination is by the kidneys, and the amount of uric acid in the urine, particularly in malarial poisoning, is apt to be decreased. Most of the salts have an oxytoxic action.

Poisoning by Cinchona.—The fatal dose of any cinchona alkaloid is unknown, and, as regards the bark, it would be difficult to ingest enough to cause fatality, because of the facility with which the stomach rejects enormous doses. Cinchonism, already mentioned (see PHYSIOLOGICAL ACTION), moreover, affords ample warning of untoward effects. A full ounce of quinine has been ingested at a single dose without inducing any very alarming effects, but foreign literature records a case where 5 ounces proved fatal.

The skin of many persons is affected in a peculiar way by the internal administration of the alkaloidal salts; these eruptions may present any of the forms of purpura, roseola, eczema, pemphigus, or even the exanthem of scarlatina.

Literature of '96 and '97.

Case in which, two days after taking 15-drop doses of compound tincture of cinchona, a patient complained of intolerable itching, which was soon followed by vesiculation on the genitals, face, and ears; the whole general surface of the body rapidly became the seat of a scarlatinoid dermatitis. As this began to decline, the palms and soles became affected with blebs, as much as eight ounces of serum being evacuated. The blebs recurred, and it was five or six weeks before recovery was complete, the palms being the last to recover. The same phenomena had before occurred from the administration of quinine. The chief points of interest are the variety of the bulbous manifestations and the great disproportion between the violence of the cutaneous outbreak and the small amount of the drug ingested. Johnston (Med. Age., Aug. 25, '97).

Therapeutics. — Cinchona - bark no longer receives general employment, partly owing to the large doses demanded, and partly because of the superiority of the alkaloids, either singly or mixed. Once in a great while it finds use in the application of a "cinchona jacket" in the agues of children, the powdered red bark being quilted between two folds of the garment, which is applied next to the skin. Cinchona (red) and snake-root, with spirit of Mindererus is also often employed as a tonic and stimulant in low forms of fever, typhoid more particularly.

Cinchonine alkaloid is found chiefly in the pale varieties of bark. Its action (and likewise that of its salts), is very similar to that of quinine, but less energetic, and requires to be given in larger doses; it is sometimes substituted for quinine, being cheaper, and when the latter commanded a high price cinchona was often employed as an adulterant.

In intermittent it has an unquestionable, but variable, action; sometimes its action is slow, whatever the dose exhibited, and the paroxysms cease gradually. It is only about two-thirds as active as quinine: a fact that must be considered when prescribing. Again, in doses of 10 to 15 grains it sometimes induces cinchonism, and which it is not usually prudent to exaggerate; further, its therapeutic action is not always proportionate to the physiological effects; for, while it sometimes answers the purpose for which it is prescribed without the latter being manifested, on the other hand, the physiological effects may be most energetic, without any evidence of therapeutic activity. It certainly cannot wholly replace quinine or its salts in severe intermittents or remittents, but

may prove a valuable adjunct. The hydrochlorate salt is admittedly the best form for administration, though the sulphate is, perhaps, more generally employed.

Cinchonine appears to act very much in the same way as quinine, but less powerfully; it depresses the heart more than quinine does. Whitla ("Pharm., Mat. Med., and Therap.," '92).

Laborde claims that cinchonine in toxic doses causes epileptiform convulsions. As a therapeutic agent it is about one-third weaker than quinine, and must be used in correspondingly larger doses. Hamilton insists that it is much superior to the latter drug as a prophylactic against malaria. As a tonic there appears to be no difference in action between the two drugs. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Cinchonine is recommended as a febrifuge for children because it is nearly tasteless; further, it and its derivatives are cheaper than other alkaloidal salts of cinchona. The hydrochlorate is the most convenient for use, and may be dispensed either in pills or solution.

Iodosulphate of quinine is known also as antiseptol, and has been recommended as a substitute for iodoform. Martindale and Westcott ("Extra Pharm.," '95).

The sulphate of cinchonine is less reliable in its action than the corresponding quinine salt, and must be given in doses half as large again. It is, however, often used for the same purposes in powder and pill. Roth ("Mod. Mat. Med.," '95).

Literature of '96 and '97.

Cinchonine salts are cheap, but their nauseous taste is objectionable. The sulphate is soluble in water, but solutions with acid are not fluorescent. Murrell, Lond. ("Manual of Mat. Med. and Therap.," '96).

The cinchona alkaloids, when swallowed in insoluble form, combine with the acids of the gastric juice and become soluble; so that, as a mere solvent, it is unnecessary to administer cinchonine with acids, and a large dose merely suspended in fluid is quite as efficacious as when dissolved.

Many observers consider that cinchonine is superior to quinine as a prophylactic. This alkaloid passes off in part by the urine, but a portion appears to be consumed in the blood or to be eliminated in some other way.

Cinchonidine is accepted as isomeric with cinchonine, and its alkaloids are used to a small extent as a substitute for the latter and its derivatives, or for quinine salts; like all the derivatives of cinchona, it is toxic and antiperiodic. It is distinguished from cinchonine by its solution being levogyrate, and from quinine and true quinidine by its acid solution not being fluorescent. Cinchonine solutions are dextrogyrate, and its acid solutions are not fluorescent; like cinchonidine, it does not give an emerald-green color with chlorine-water and ammonia like quinine and quinidine.

Cinchonidine resembles both quinine and cinchonine in action, but is less powerful than the first, being about equal to the latter. Like cinchonine, it depresses the heart more than quinine. Whitla ("Pharm., Mat. Med., and Therap.," '92).

Cinchonidine sulphate is very useful in malaria, and it is less bitter and more soluble than quinine; it is said not to produce the severe head symptoms caused by the latter. Hare ("Prac. Therap.," '94).

Clinical experience has proved the cinchonidine salts to be reliable tonics and antiperiodics. They are said to be eliminated by the kidneys unchanged; also to produce less disagreeable symptoms, both gastric and cerebral, than quinine; but Rafferty, who administered more than three hundred ounces, affirms that it is apt to cause nausea and vomiting. The bromo-hydrate has been employed hypodermically. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Cinchonidine is preferable to cinchonine, since the latter is nauseous and liable to cause stomachic derangement. It is less expensive than quinine, more

so than cinchonine, and can be used with effect as an antipyretic. In intermittent fevers, malaria, and neuralgia it has a distinct value of its own, acting as rapidly and efficaciously as, though not a substitute for, quinine; patients are more capable of resisting fresh malarial poisoning than after the latter. Martindale and Westcott ("Extra Pharm.," '95).

Quinetum.—This, as before mentioned, is known also as "cinchona febrifuge." It is an amorphous, dirty-white powder consisting of mixed alkaloids obtained from the red-cinchona grove at the government plantations, Darjeeling, India; the alkaloids are in the same proportion as found in the bark. The sulphate is a more presentable salt, and resembles quinine sulphate. As the substance known as quinetum consists chiefly of cinchonidine salts (from 50 to 70 per cent.), these latter probably will offer an efficient substitute. Nevertheless, it has almost replaced quinine in India, and is said to be more readily absorbed into the system than the crystalline alkaloids.

Quinetum, or "hospital quinine," is a mixture of the alkaloids of the bark, and has been found very efficacious in chronic cases of ague. Farquharson ("Therap. and Mat. Med.," '89).

Quinetum possesses all the properties of the bark from which it is derived except astringency, the latter power being but feeble. It is a cheap substitute for quinine, and has been used as a febrifuge and antiperiodic with excellent effect, also in all affections in which quinine is valuable. Whitla ("Pharm., Mat. Med., and Therap.," '92).

Quinetum sulphate may be given in pill form with glycerin of tragacanth, or in aqueous solution with acid and tincture of orange-peel. It is not nauseously bitter, and there are no unpleasant effects during its administration; does not produce deafness, and is said to be more powerful than quinine. Martindale and Westcott ("Extra Pharm.," '95).

Esencia de calasaya embodies all the alkaloids in standard proportions of calisaya-bark, and is a fluid, palatable, cinchona febrifuge. It has been used with most satisfactory results in the treatment of febrile maladies, more especially those of malarial origin; as a stimulant bitter in functional derangements of the stomach; and as a tonic in dyspepsias. McCausland (Aust. Med. Jour.; Bull. of Pharm., '91).

It is a well-known fact that the combined alkaloids of the cinchona-bark are much more effective as a tonic than any one of them taken singly. They are to be preferred in combination also, in many instances, as an antiperiodic, particularly when the periodicity of the attack has been in some degree mitigated. It is for this reason that the East Indian Government now provides its officials with "cinchona febrifuge,"—which is merely a combination of cinchona alkaloids—in preference to quinine. While cases are encountered where quinine is practically indispensable for a time, there are few which will not readily yield, and more satisfactorily, to a combination of cinchona alkaloids. Esencia de calasaya and cinchona febrifuge are practically identical, save that the former is a fluid medicament, the latter a powder. The esencia, moreover, is an ideal general tonic, and is particularly useful in atonic dyspepsia. In the alcohol habit it satisfactorily neutralizes the craving for spirits, and will be found of great service in treating this disease. Wingrave, Lond. (Med. Age, Sept. 25, '93).

Literature of '96 and '97.

Quinetum is described as a mixture of cinchona alkaloids, cinchonidine predominating. It has been recommended as an antiperiodic in malarial affections. Foster ("Prac. Therap.," '96).

Quinidine is believed to have the same action and medical properties as other cinchona salts, and to be equally as efficacious as quinine without giving rise to the disagreeable nervous effects occasionally observed when the latter is given in large doses. Hare says the dose should

be double that of quinine, but it would seem preferable not to greatly surpass the dose of quinine.

> Quinidine sulphate is a valuable antipyretic and antiperiodic, but chiefly used in lieu of quinine (in the same proportions) where large doses of the latter are required to bring down fever-heat in rheumatism, typhus, typhoid, and pneumonia. It is very suitable for administration to children, who do not object to its taste as they do to that of quinine. Whitla ("Pharm., Mat. Med., and Therap.," '92).
>
> It probably closely resembles quinine in its physiological and therapeutic properties, and is an efficient antiperiodic. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Quinoidine, or Chinoidine.—There is little to say regarding this substance further than that it partakes of the nature and characteristics of other cinchona preparations. As before remarked, it is a by-product, chiefly a mixture of such alkaloids as are not readily extracted, left after the major portion of the same have been crystallized out. It may be resolved into ordinary quinine, cinchonine, and quinidine alkaloids, but is not generally held a profitable measure. Solutions in either boric or sulphuric acid are employed as cheap febrifuges, but their taste is very nauseous. Quinoidine is neither as certain in composition or uniform in effects as quinetum.

Quinovic, kinovic, or chinovic acid is little employed, as it offers no advantages over other cinchona derivatives: it poses rather as a chemical curiosity than as a medicament.

Cupreine is nearly allied to quinine, and generally on extraction from cuprea-bark found conjoined with the latter: a combination that for a time obtained the title of homoquinine, it being supposed to be a specific alkaloidal entity. Both sulphate and muriate salts are manufactured, but neither the two latter nor the alkaloid—though purported to be equally as efficacious therapeutically as the quinine and its salts—have as yet secured a permanent position in the materia medica.

> Cupreine, subcutaneously administered, produced in dogs, rabbits, and guinea-pigs a local anæsthesia at the point of injection, the effect lasting several days, but no tremors or any other convulsive phenomena were observed. For guinea-pigs the fatal dose was double that of quinine. Grimaux (Les Nouv. Remèdes, July 8, '94).

For further consideration of the therapeutics of the cinchonas and their derivatives, the reader is referred to QUININE.

G. ARCHIE STOCKWELL,
(Central Staff).

CINNAMON AND DERIVATIVES.—Cinnamon is the inner bark of the shoots of the *Cinnamomum Zeylandicum* and *C. aromaticum*: beautiful evergreen trees twenty to thirty feet high and twelve to eighteen inches in diameter, cultivated in many portions of the East Indies. The bark comes in long, closely-rolled quills, composed of eight or more layers; is of pale-yellowish-brown hue, the inner surface striated; fracture splintery; odor fragrant and warmly aromatic, and taste sweet. Some forms are more coarse in taste and odor. Cassia-buds are the calyces surrounding the young germ. The term "cassia" is frequently applied to Chinese and Saigon cinnamon, which is less expensive and more generally marketed in the United States than Ceylon cinnamon.

Preparations and Doses.—Cinnamon-bark (powdered), *ad libitum.*

Cinnamon powder, compound, 10 to 30 grains.

Cinnamon- (cassia) oil, 1 to 3 minims.

Cinnamon extract, fluid, 15 to 30 minims.

Cinnamon infusion, 60 to 120 minims.

Cinnamon tincture, 60 to 180 minims.

Cinnamon tincture, compound, 30 to 120 minims.

Cinnamon spirit (essence), 10 to 30 minims.

Cinnamon syrup, 1 to 2 drachms.

Cinnamon-water, *ad libitum*.

Cinnamic acid, $^1/_4$ to $^3/_4$ grain.

Cinnamic aldehyde, not employed medicinally.

Cinnamyl-acetate, not employed.

The compound, or aromatic, powder of cinnamon is made by adding 35 parts of ginger, 15 of cardamom, and 15 of nutmeg, to 35 parts of cinnamon.

Physiological Action.—Cinnamon is a warm aromatic, acting as a true stomachic by a gentle stimulating action on gastric mucous membrane, increasing its secretion and assisting digestion; hence its general employment as a condiment. It is also hæmostatic, oxytocic, and slightly astringent. The oil and cinnamic acid are also antiseptic, and the acid is claimed to be antituberculotic: a claim not altogether satisfactorily substantiated. By some, cinnamon is held to be contra-indicated in all inflammatory states of the gastro-intestinal tract.

Therapeutics.—The scope of the drug is not a very extended one, and it is chiefly employed to render mixtures more palatable.

The eclectics generally regard cinnamon a powerful specific styptic: a claim that appears to be fairly well substantiated by general therapeutic literature. It certainly has, on many occasions, proved most efficacious in epistaxis, hæmoptysis, hæmaturia, and uterine hæmorrhage. In tedious labors dependent upon atony of the uterus and insufficiency of contractions, cinnamon proved quite efficacious in the hands of Mursinna and Thomas Hawkes Tanner.

> This drug specifically influences the uterus, controlling hæmorrhage and stimulating contraction of its muscular fibres. In small and repeated doses it is capable of producing abortion; hence it is indisputable that it exerts a powerful influence on the nutritive functions of the womb. It is possible that more study and experimentation will reveal the drug to be possessed of further remedial virtues. Webster ("Dynam. Therap.," '93).
>
> It acts upon the uterus like, though much less powerfully than, ergot, and probably also on the smooth muscular tissue in general—and as a styptic and astringent. It is employed, therefore, as an adjuvant to remedies for diarrhœa; in the second, non-febrile stage of acute intestinal catarrh; and in torpidity and slight hæmorrhages of the uterus, usually in combination with ergot. Roth ("Mod. Mat. Med.," '95).
>
> Though used as an aromatic, its chief use is to control uterine hæmorrhage, and it acts promptly by contracting the bleeding vessels; it is also of considerable value in some forms of diarrhœa. Locke ("Mat. Med. and Therap.," '95).
>
> Thirty cases of dysentery were permanently relieved by employing from one to six doses of the Persian remedy: a drachm of powdered cinnamon made into a bolus with a few drops of water and swallowed with as little fluid as possible. Avetoom (Lancet, Lond., vol. i, Mar., '95).

As an Antiseptic.—Cinnamon, cinnamic acid, cinnamic aldehyde, and the oil of cinnamon doubtless possess antiseptic power, and may be advantageously used in the treatment of purulent foci and necrotic processes. It is owed to this property that it has occasionally proved of some value in pulmonary tuberculosis.

> No living disease-germ can resist for more than a few hours the antiseptic power of essence of cinnamon; even its scent will kill them. The essence is as effective as corrosive sublimate. An in-

fusion of cinnamon is valuable in influenza, typhoid fever, and cholera. Chamberland (Med. Age, Apr. 25, '94).

Cinnamic aldehyde, or cinnamic acid, has recently been employed as an antiseptic in the various forms of tuberculosis, with encouraging results. Stevens ("Man. of Therap.," '94).

The oil of cinnamon is powerfully antiseptic and may be used in dilute form in the dressing of wounds, and by injection in gonorrhœa; in the latter disease it acts best in the early stage. Cinnamic acid is also used for the same purpose. Hare ("Prac. Therap.," '94).

A solution of 1 part of cinnamic acid in from 10 to 20 parts of glycerin proves an excellent remedy in tuberculosis, particularly of joint-cavities; it may be injected into the joint, into the fungous mass, or into the gluteal muscles. Likewise it may be employed in pulmonary and intestinal tuberculosis. Leucocytosis begins in from an hour and a half to two hours after the injection, and reaches the maximum in eight hours. The leucocytes are increased, and there is no decrease in the red corpuscles or the hæmoglobin. Landerer (Therap. Monats., Feb., '94).

Literature of '96 and '97.

Oil of cinnamon in aqueous solution acts like magic as a local disinfectant. Healing of wounds takes place without suppuration if kept wet with a compress saturated with cinnamon-water, which takes the place of corrosive sublimate and everything else; is pleasant to use, non-toxic, safe, and cheap; it is the ideal douche after parturition, and serves an equally good purpose in nasal catarrh. Baggott (Med. Age, Sept. 25, '97).

It is probable that oil of cinnamon cures consumption in two ways: In the early stage of catarrhal phthisis by so directly affecting the bacilli as to stop their growth; in cases farther advanced by only allowing organisms incapable of growth to pass along the bronchi, and thus prevent the infection of fresh lobules. In this way the disease may be limited to small areas, where it can be dealt with by the vital processes of the body, and cut off from the system by the formation of fibrous tissue, and so cease to be an immediate source of danger. It is interesting to observe the order in which the symptoms subside: The expectoration and cough are the first to improve; then the temperature tends toward the normal; finally the weight begins to increase; and all these are accompanied by gradual diminution in the number of the bacilli in the sputum. Thompson (Brit. Med. Jour., vol. ii, '97).

Febrile Diseases.—In low stages of fever, and where there is persistent nausea and vomiting, some of the cinnamon preparations appear absolutely magical in effect, but the causes of the latter condition are so varied, and fevers so protean in their aspects, that no one remedy can be relied upon on all occasions.

It has been recommended in malarial diseases, but, at best, it can only be considered as a *succedaneum*.

CIRRHOSIS OF THE LIVER.

Definition.—Suggested by Laennec as a name for one particular condition of the liver, the term "cirrhosis" was not only found to be of immediate utility, but, like many other useful words, has rapidly acquired secondary meanings, and unfortunately the pathologist and the clinician disagree in the secondary meaning which they assign to the term. Hence a definition of "cirrhosis" satisfactory to all parties cannot well be given. In short, the word, by becoming too useful, threatens to outlive its usefulness. The pathologist employs it to indicate all those conditions in which there is a generalized, as opposed to localized or focal, development of increased amounts of fibrous tissue in the organ; the clinician recognizes as included in the term all those conditions characterized by connective-tissue overgrowth in connection with the liver, whether the overgrowth

be focal or general, whether it affect the interior of the organ or the peritoneal capsule, and urges in favor of this view that all these conditions may give rise to a like series of symptoms; while, on the other hand, he is unwilling to include under the terms such forms of connective-tissue overgrowth as give rise to no recognizable symptoms. According to this view, the gummatous liver of tertiary syphilis is cirrhotic, as is also the condition of chronic productive perihepatitis in which the capsule alone is affected, while the development of fibrous tissue in the centres of the lobules which may accompany chronic venous congestion of the organ is not to be classed as a cirrhosis.

Remembering that Laennec employed the word in association with a generalized fibrosis of the organ, and not to indicate the complex of symptoms induced by this condition, and recognizing, also, that it is impossible to restrict it nowadays to the one form which he described, the definition accepted by the pathologists more nearly approaches the original acceptation of the term, and will be adhered to in this article. At the same time, adequate reference will be made to such conditions as are not included in that definition, but which are regarded as cirrhosis by a large number of clinicians.

Classification.—Starting, then, with this definition, and including under the term all those states in which there is a generalized overdevelopment of connective tissue throughout the liver, it will be well, before attempting any classification, to pass in review the factors which primarily induce this overgrowth.

Our knowledge of the causes leading to fibrosis elsewhere, imperfect as it is, leads to the belief that inflammation is the main factor,—not acute, but, as it is termed, "productive." It may be brought about by the action of a mild irritant extending over a relatively-long period, or by the recurrent action of a somewhat more severe irritant. In either case there is a stimulus afforded to the proliferation of the connective-tissue cells of the part—and the new growth corresponds to the granulation-tissue seen in a healing exposed wound. A prominent feature in fibroid tissue of this nature is its liability to contract. It would appear that in the commonest form of cirrhosis, the portal, or atrophic, this is the main process at work, the irritant reaching the liver by the portal vein and especially manifesting its activity by setting up an irritation along the interlobular branches of that vein.

This, however, is not the only form of inflammatory fibrosis. There may be a new development of connective tissue—a *replacement* fibrosis—to take the place of cells of a higher order, which, through the action of some irritant or disturbance, have undergone destruction, and it is still a matter of debate whether, in portal cirrhosis even, such replacement-fibrosis is not largely concerned in the new growth. Of more recent observers Sieveking, examining twenty atrophic cirrhotic livers by the Van Gieson method of staining, concluded that the connective-tissue growth was the first disturbance. Markwald came to the opposite conclusion: that necrosis of the peripheral liver-cells is the first event in the disease; and Ruppert describes both productive formation of connective tissues and inflammatory atrophy of the liver-cells. Personally I cannot but regard this last view as the one most in harmony with the appearances seen in the majority of cases of well-defined portal cirrhosis.

In one form of cirrhosis,—the pericel-

lular or interstitial,—of which in man the liver of congenital syphilis affords the best example,—replacement-fibrosis is the distinguishing feature. In this the various stages of cellular atrophy can be well followed, and the little groups of cells are to be seen surrounded by delicate new tissues of a character very different from that of the dense connective bands seen in portal cirrhosis. The difference makes itself evidenced by the gross appearance of the organ, for this form of fibrous tissue does not contract, the surface remains smooth, and the organ is enlarged instead of being diminished in size. It may be urged that this enlargement is a proof of the productive character of the process, but the enlargement appears to be due, in the main, to a lack of pressure-atrophy of the hepatic parenchyma so characteristic of portal cirrhosis, coupled with a compensatory proliferation of the liver-cells to replace those which have been destroyed. A proliferation or hypertrophy of this nature is occasionally well marked in the portal form, resulting in the formation of islands of new liver-tissue and the production of a large hobnailed liver. Rarely the new growth of the parenchyma advances to an adenomatous or even cancerous condition, and we meet with a greatly-enlarged irregular cirrhotic liver with multiple neoplastic masses derived from the liver-cells.

If this process be the explanation of the hypertrophied liver of pericellular cirrhosis, then the appearances in biliary cirrhosis proper present macroscopically and microscopically so many points of approximation to what has just been described, that the fibroid overgrowth here may well be largely of the nature of a replacement-fibrosis. The tendency is for recent observers to regard it as such, and to consider that biliary cirrhosis of the type which has especially been studied by Hanot is a cholangitis in which either the bile-capillaries within the lobule, or the cells bordering upon these, are especially affected. These liver-cells undergo gradual atrophy and replacement by new connective tissue. Goluboff regards this form as being primarily due to the chronic, diffuse, catarrhal angiocholitis with chronic, diffuse periangiocholitis. Now, a catarrhal angiocholitis affecting the smallest bile-ducts affects the capillaries also, and is inevitably a process affecting the liver-cells themselves. But, while accepting these views with regard to the main characteristics of the fibroid changes of these two important forms of cirrhosis, it must, I think, be admitted that, save in relatively-rare instances, the organs affected by one or other form of the disease show a mixture of both productive and replacement changes.

There are yet other ways in which fibroid tissues may be developed in various organs without recognizable inflammatory disturbance, and, as I have pointed out in the Middleton Goldsmith Lectures (1896), there may be increased development of fibrous tissue of a functional type. Such fibrosis is to be recognized in connection with altered conditions of the arterial, venous, and lymphatic circulation. It is difficult to say how far such forms manifest themselves in the liver. On the whole, the evidence is against there being any extensive development of new connective tissue in the organ from such a cause; but it may well be that the indurative form of passive congestion of the organ and the growth of fibrous tissue around the interlobular branches of the hepatic vein, in cases where there is long-continued obstruction of moderate degree brought about by either heart or lung disease, are

to be regarded as due to a laying down of new connective tissue around the hepatic venules of non-inflammatory origin.

It is evident that, inasmuch as our definition is based upon the one condition of overdevelopment of fibrous tissue in the organ, a proper classification of the various forms of cirrhosis cannot be based primarily or adequately upon the disturbances occurring in other parts of the body as secondary results of the hepatic fibrosis, but must be either etiological and made dependent upon the various causes leading to the development of fibrous tissue or, on the other hand, must—anatomically—be determined by the parts of the liver which are the primary seat of the development of the new tissue. Our knowledge of these cirrhoses is still insufficient for either the etiological or the anatomical classification to be ideally perfect. Against the etiological classification it may be objected that we are still uncertain as to how far the commonest form—portal cirrhosis—is due to the direct action of alcohol, how far it is due to the absorption of toxic substances from the intestinal canal secondary to the gastritis and enteritis induced by alcohol; nor again does the mere enumeration of causes help us in every case to distinguish the special type of cirrhosis which those causes induce, and so, the symptoms depending upon the form of hepatic disturbance, such a classification can be of little clinical value.

On the other hand, the anatomical classification is imperfect to the extent that, while the disease may begin by affecting one special portion of the liver, as the process of fibrous-tissue development extends, it involves many other parts, and, consequently, in well-developed cases cirrhosis is anatomically of a mixed type, and it is far from easy in such cases to determine how the condition originated. The fullest etiological classification is that given by Chauffard, and this has, at the same time, the advantage of being anatomical. He divides the cirrhoses as follows:—

1. Vascular (originating around the vessels).

(*A*) Toxic { 1. Due to ingested poisons.
2. Due to autochthonous poisons.

(*B*) Infectious { 1. By the direct action of microbes. (*a*) Local.
2. By their indirect action through their toxins (or, as he terms it, toxi-infection). (*b*) Extra-hepatic.

(*C*) Dystrophic { 1. Arteriosclerotic.
2. Congestive.

2. Biliary.

(*A*) Due to Biliary Retention.

(*B*) Due to Angiocholitis of the Smaller Bile-ducts.

3. Capsular.

(*A*) Chronic Localized Perihepatitis.

(*B*) Chronic Generalized Peritonitis.

Admirable as is this classification, it is difficult to see how we are to make the distinction which is here made between the toxic cirrhosis and the toxi-infective. Anatomically and clinically, poisons—whether absorbed from the stomach or developed in the system itself, or again passing into the blood as a result of the growth of micro-organisms, or again given off by micro-organisms within the liver itself—may produce similar lesions in the liver, and as a consequence bring about closely allied, if not identical, anatomical changes in the organ with the development of like symptoms. The distinction thus raised by Chauffard between these various forms is too fine for practical use; clinically, his subdivisions are almost valueless; hence, in this article, I have divided the cirrhoses according to anatomical grounds alone, and shall recognize the following forms of cirrhosis according to the origin of the process:—

1. Portal cirrhosis, in which the process appears to begin especially around the branches of the portal vein.

2. Biliary Cirrhosis.—(*a*) In which the process manifests itself around the larger bile-ducts. (*b*) In which the process more especially shows itself around the smallest bile-ducts and in connection with the bile-capillaries.

3. Pericellular cirrhosis, characterized by the development of fibrous tissue throughout the lobule around the individual cells and groups of cells.

4. Arterial cirrhosis, in which are chronic periarteritis and development of fibrous tissue around the arteries.

5. Centrilobular cirrhosis, characterized by the development of fibrous tissue around the interlobular branches of the hepatic vein.

6. Secondary, or centripetal, cirrhosis, due to the extension inward of a chronic fibroid inflammation secondary to chronic productive perihepatitis.

7. Sporadic cirrhosis, secondary to focal necroses scattered through the organ or to the development of inflammatory foci in no one well defined portion of the liver-tissue, which act as centres from which there radiates a fibroid change.

Of these different forms it must be repeated that all are not clinically recognizable and that it must be clearly borne in mind that a change beginning in one anatomical region of the organ is, by its extension, peculiarly liable to affect other regions. I will now proceed to consider these various forms, calling attention to those which are clinically important and those which are, up to the present time, clinically unrecognizable.

Portal Cirrhosis.

Etiology.—This form of cirrhosis is most frequently associated with alcoholism, more especially with the use of spirits, and as a consequence has become known in England as the gin-drinker's liver. At the same time a small proportion of cases is met with in which there is an entire absence of the alcoholic history.

Upon this continent all other causes are insignificant when compared with the one prime cause of excessive and long-continued use of alcohol.

While this is the case and while alcohol must be regarded as a prime cause, much evidence has accumulated of late years to throw doubt upon alcohol as the primary cause. As Payne has pointed out, cirrhosis of the liver is the exception and not the rule in autopsies upon drunkards; the fatty, and not the cirrhotic, liver is typical of alcoholism. Besides this, the experiments of a large number of observers have failed to demonstrate that ethylic and not amylic alcohol is capable of producing any marked development of cirrhosis in the livers of rabbits, dogs, pigs, or rats. In fact, only three observers, Straus and Blocq in the rabbit, and de Rechter in the dog and rabbit, have observed such cirrhotic changes. Magnan, Ruge, Pupier Nairet, Combemale, Strassmann, Afanassijew, von Kahlden, Lafitte, and Kerr have found almost entire absence of portal inflammation, but have noticed more or less extensive fatty infiltration and fatty degeneration.

It may be urged that these observers did not preserve their animals for a sufficient length of time; nevertheless, several of the observers kept their animals for several months, and, were alcohol the direct cause of the disease, there should undoubtedly have been more evidence of, at the least, a beginning inflammation in the portal sheaths around the lobules.

Literature of '96 and '97.

Experiments during which cirrhosis of the liver was sometimes obtained by injecting cultures of staphylococcus pyogenes aureus into the muscles as well as into the intestinal canals of birds, etc. The hepatic cirrhosis was accompanied in most cases by a similar change in the kidneys. Similar results obtained with the bacillus pyocyaneus, the bacteria of putrefaction, and the cholera vibrio, and by prolonged use of a sterilized culture of bacillus pyocyaneus, thus corroborating Charrin's observations. Alcohol in the production of hepatic cirrhosis acts only as an antecedent agent, producing a gastro-intestinal catarrh, which, in turn, may result in the production of abnormal putrid matters or ferments, which may be absorbed by the portal vein, and, being carried to the liver, give rise to interstitial changes. Krakow (Arch. de Méd. Expér. et d'Anat. Path., No. 2, '96).

Experiments on animals in which cirrhosis did not follow the ingestion of bacterial products. In one case, however, alternate doses of toxins and of alcohol caused cirrhosis. Study of the toxicity of the fæces tending to show that alcohol does not necessarily increase the production of poisonous bodies in the alimentary canal, but that it acts as a cellular poison on the liver-cells, and so interferes with the destruction of toxic bodies in the liver, and that the liver-cells themselves become affected. If this is often repeated for a long time, cirrhosis results. Ramond (La Presse Méd., Apr. 21, '97).

This discrepancy between the experimental results and the history given in man of alcoholism is to be explained in two ways: Either it must be admitted that alcoholism is the primary factor in cirrhosis, in which case it has to be acknowledged that individual predisposition plays a part of almost equal importance; so that cirrhosis is to be described as being due to the fibrotic or cirrhotic diathesis manifesting itself under the influence of alcohol. Or, on the other hand, we must regard alcohol purely as a predisposing cause, and must pass beyond the alcoholism and admit that, at most, alcohol causes irritation and inflammation of the gastric intestinal mucosa, whereby either toxic substances pass into the portal blood from the intestines (and regard these toxic substances as the direct cause of the inflammatory condition of the organ), or it is possible to go further and regard the inflammation as set up by some form of micro-organism entering the liver along the same paths. Upon the whole, the toxic, as opposed to the direct alcoholic, view would appear to be the more correct.

All recent work appears to be leading to the conclusion that portal cirrhosis of the liver is brought about by a condition of toxicæmia. Of special interest in this connection is the observation of Flexner, who found that by injecting a 1-per-cent. solution of dogs' serum, which had been kept for twenty-four hours, into the vein of a rabbit, the animal showed almost immediate evidences of profound blood disturbance in the shape of hæmoglobinuria, and in a week began to lose weight, and, dying at the end of the second week, presented in its liver most marked evidences of beginning portal cirrhosis.

This view that cirrhosis is the result of an intoxication following gastro-intestinal disturbance is that held by Hanot and the majority of recent French workers.

[Lévi has gone so far as to suggest that the condition may be set up directly by bacteria. In a case of a young male of 17, in whom he found periportal cirrhosis and greatly enlarged spleen, with, in addition, bacterial endocarditis of the pulmonary valve, albuminuria, and suppurative meningitis, he discovered a diplococcus pathogenic in guinea-pigs. From his description, the cirrhosis was of a rather mixed type, for, along with the

rich connective-tissue overgrowth, there was well-marked proliferation of bile-canaliculi directly connected with the liver-cells. The condition lasted for fifty-one days, and, while it is possible that such extensive cirrhotic changes might have been produced in this time, the other lesions make it doubtful whether he was dealing with a condition of cirrhosis directly due to the micro-organism; certainly it cannot be said that the case is one of ordinary cirrhosis. J. George Adami.]

On the other hand, the not-infrequent presence of inflammation surrounding the atrophic liver and the frequent presence of a right-sided pleurisy (which is suggestive of an extension of the inflammatory process through the diaphragm into the pleural cavity) make it not impossible that some cases, at least, of portal cirrhosis are due to something beyond the action of toxins and irritants conveyed by the blood, and makes it probable that some cases are associated with the presence of definite bacteria.

Besides these toxins, whether elaborated in the intestinal canal and absorbed, or due to the growth in the system of bacteria, other poisonous substances may lead to the developing of cirrhosis.

Of such absorbed toxins it has been suggested by Budd that the frequent cirrhosis found in the natives of India, who never partake of alcohol, is secondary to the irritation and gastritis produced by highly-seasoned foods; and Segers describes an atrophic form in the Terra del Fuegians brought about by eating mussels. He obtained from these mussels a poison which was definitely toxic for dogs and rabbits. Such cirrhosis is not infrequent in lead poisoning, and Lafitte states that, giving lead to rabbits with their food, he induced a cirrhotic condition in their livers. Eichhorst's case of nodular cirrhosis due to chronic phosphorus poisoning would come under the same category.

Cirrhosis of the liver manifested among the Fuegians, who eat from 12 to 25 pounds of mussels daily, whether good or bad. The mussels are toxic only at a certain period of their development; the toxic effect is not due to microbes, but to some chemical product. Chronic mussel poisoning is curable up to a certain point, when it is manifested only by enlargement of the liver. When it has arrived at its second period, that of atrophic cirrhosis, it is rapidly fatal. Segers (La Sem. Méd., Nov. 4, '91).

All these are cases of disease possessing a similar character, namely: characterized by the development of the inflammatory new tissue in the portal sheaths and more especially around the branches of the portal vein. For the present time I leave out of account the other forms of cirrhosis which are of a different type brought about by other toxic agents and the consequent development of inflammatory foci or focal necroses irregularly scattered through the liver-substance.

Literature of '96 and '97.

Neither drugs, — *e.g.*, alcohol, phosphorus, etc., — nor embolism of the portal vein, nor ligature of the hepatic artery or bile-duct, or other operative procedure, nor acute yellow atrophy, nor long-standing venous congestion, can produce a true hepatic cirrhosis. One or other of these causes might result in cellular degenerations or necrosis. Such necrotic foci might come to be incapsulated by fibrous tissue, but this is not a cirrhosis, which, in the proper sense of the term, is a progressively-advancing interstitial hepatitis. The same objection obtains as regards the interstitial changes which are seen passing inward from the capsule as a sequel to long-standing and progressive cases of fibrous perihepatitis. There is marked difference between the cirrhotic changes that follow upon parenchymatous degenera-

tion and the true classical interstitial hepatitis, which arises as a primary condition. Siegenbeek von Heukelom (Zeigler's Beitrage, B. 20, H. 2, No. 221, '96).

AGE AND SEX.—With regard to sex, the condition affects males more than twice as frequently as it does females; indeed, some authorities would make it as much as three times more frequent in males. From the more recent statistics of Rolleston and Fenton, and of Kelynack, it would appear that the most common age at which death occurs is between 40 and 50; two-thirds of the fatal cases occur between 35 and 50. Rolleston gives the average age in males having an alcoholic history as 48, without alcoholic history, 49, and in females 46 and 51, respectively. Kelynack gives the average of his 121 cases as: males, 45½; females, 42. But the condition may develop at almost any period of life; numerous cases have now been brought forward in children since Palmer Howard published his classical article on this subject.

Pathology.—In alcoholics, in whom the condition most frequently develops, the liver is, at first, large, owing to the fatty infiltration and hepatic congestion, both of which are the direct result of alcoholism. In what is taken to be the earliest stage there is observable an abnormal collection of small, round cells infiltrating the portal sheaths and causing them to stand out prominently in the stained sections, the greatest accumulation being in the neighborhood of the vessels running in those perilobular sheaths. These small cells have rounded, and not polymorphous, nuclei, and are generally regarded as being, in the main, embryonic, connective-tissue cells. In somewhat more advanced conditions the sheaths have undergone definite enlargement and are formed of dense, fibrous tissue, although there is still an abundant infiltration of small, round cells more especially at the margins where they abutt upon the lobular parenchyma. Just as at the beginning the infiltration is not evenly distributed around the lobules, so in more advanced conditions the development of fibrous tissue is not even, and as a consequence the newly-formed bands of fibrous tissue tend to surround many lobules; the fibrosis is what is termed *multilobular*. As this inflammatory new connective tissue reaches maturity, it contracts and by its shrinkage is produced the nodular and hobnailed surface of the organ. In regions or cases in which this process of connective-tissue formation has reached its limit or is not progressing, the new bands are sharply defined from the included parenchyma of the organ; where it is continuing to advance there is not the same sharp separation; small groups of liver-cells at the periphery of the lobules may be seen more or less surrounded by strands of newly-forming fibrous tissue and exhibiting well-marked signs of atrophy.

There is still much debate as to whether of necessity the first stage of portal cirrhosis is characterized by enlargement of the organ, and some recent writers, including Osler, would draw a distinction between the ordinary atrophic and the fatty cirrhotic liver. It is true that patients may die of intercurrent disease when the liver is still enlarged and fatty, and that, on the other hand, patients may only exhibit symptoms of cirrhosis when the organ is already so contracted as to be scarcely, if at all, palpable. But, taking into consideration the direct effects of alcoholism and calling to mind three or four cases in which, by good fortune, careful notes of the size of the liver were taken during the months preceding symptoms of portal obstruction, I cannot but uphold the view that

portal cirrhosis (where associated with alcohol) has a preliminary stage of hepatic enlargement. Where alcoholism is not intimately connected with the development of the condition there, such preliminary enlargement may not, of necessity, form a stage in the development of the condition.

Literature of '96-'97-'98.

Study of 37 fatal cases of cirrhosis of the liver. Cirrhosis with enlargement, without change in size, and with diminution in size, are equally frequent. The size of the liver is increased in one-third of the cases. The male sex is more frequently affected. Cirrhosis with enlargement is more common in younger people, and cirrhosis with atrophy in old. The average duration of symptoms is longer in the atrophic cases. The duration of symptoms, however, varies within wide limits in all varieties. Hæmorrhage is a not-infrequent cause of death in all forms, and a fatal hæmorrhage may be the first symptom, even in the hypertrophic form. An alcoholic history was obtained in every case in which the subject was investigated. A history of previous malaria, syphilis, or gall-stones was occasionally obtained, but in none did it seem of etiological importance. Morse (Boston Med. and Surg. Jour., Mar. 10, '98).

It is remarkable how extreme may be the atrophy of the organ as a result of this fibroid contraction. Cases are on record in which in place of the normal 50 to 60 ounces (1500 to 1800 grammes), the organ has weighed from 16 to 10 ounces and even less, and notwithstanding this the main symptoms of the disease may not be referable to the diminished activity of the organ so much as to the secondary disturbances of the portal circulation. Despite the great development of contracting fibrous tissue around the lobules, bile may yet find its way from the bile-capillaries into the bile-ducts, and the fibrous bands, instead of appearing to be anæmic, appear to possess abundant blood-capillaries. Obstruction there is to the portal circulation, and yet these capillaries can be easily injected from the portal vein; so that it is not necessary to assume, as some have done, that the blood-supply of the liver in this form of cirrhosis is, in the main, conveyed by the branches of the hepatic artery. As a result of the process, the organ is dense, firm, and of almost leathery consistence, presenting, on section, minute islands of reddish-yellow parenchyma of varying size surrounded by the more glistening bands of connective tissue. If the condition be complicated with jaundice, then the islands of liver-tissue more especially are tinged by the bile-pigment; if with hæmochromatosis (pigmental cirrhosis), both fibrous and liver-tissue may show a darker, slaty tinge; if the liver-cells still retain a fair amount of fat the islands of parenchyma appear of a paler yellow; if the process has been of more acute development, then with the fibrosis there may be inflammatory congestion, and the organ, in general, have a reddish appearance.

In general, the left lobe is more affected and more shrunken than the right; sometimes it is singularly small,—a mere appendage to the larger right lobe; but this is not constantly the case, and the opposite may occur. It must be kept in mind that the right lobe may be contracted behind the ribs and the left still be prominent: a condition which has more than once led to the mistaken diagnosis of hepatic or pancreatic tumor.

Varieties of Portal Cirrhosis.—Thus far I have treated of portal cirrhosis in general, but it must be recognized that there are several varieties and stages in which the condition may manifest itself. The unfortunate employment of the term

"atrophic" has led to not a little confusion and failure to recognize that these several varieties are but manifestations of one and the same process.

It may, in the first place, be questioned whether the disease always presents the same slow rate of development. Apparently this is not the case; we may have either acute or chronic cirrhosis. The London school of pathologists is inclined to recognize the red atrophic liver, characterized by the presence of large islands of yellow, fattily-degenerated parenchyma surrounded by greatly-reddened congested tissue, which, under the microscope, shows abundant signs of a subacute productive inflammatory condition, with leucocytic infiltration and the development of new connective tissue. It is still a matter of a little doubt as to whether this condition is truly a portal cirrhosis.

The cases brought forward by Cayley and Carrington and others all appear to be of this nature. There is a history of excessive indulgence in alcoholism, of preliminary slight gastric disturbance with signs of epigastric oppression, contraction of the liver, and development of ascites accompanied by more or less jaundice. The gross appearance of the liver is not greatly unlike that of acute yellow atrophy; but death takes place not in a few days or weeks, but in two or three months after the first symptoms are complained of.

Literature of '96 and '97.

Cases of acute yellow atrophy of the liver which are not rapidly fatal develop into typical examples of cirrhosis of the liver. Von Kahlden (Münchener med. Woch., Oct. 5, '97).

On the whole, therefore, I am inclined to classify this red atrophy as an acute condition of portal cirrhosis.

As will be readily understood, the vast majority of cases are, in the nature of things, chronic.

Thus, to classify the different varieties:—

(*A*) Acute: Red Atrophy of the Liver.

This condition has just been referred to.

(*B*) Chronic: 1. Enlarged Fatty Cirrhotic Liver.

The organ in this condition is markedly enlarged, shows but slight nodulation, and microscopically presents a not-far-advanced condition of cirrhosis. In a large number of cases it is unaccompanied by ascites, although the spleen may be enlarged; it occurs essentially in alcoholics and may not be recognized until after death from some intercurrent disease.

2. The Atrophic Hobnailed Liver. —The characteristic form of the disease. The organ greatly reduced in size, with surface studded with nodules of varying size, generally small; very dense and leathery; generally accompanied by marked ascites and other evidences of portal obstruction, and enlarged spleen. On section, of yellowish-red color, showing well-developed, glistening bands of fibrous tissue separating off small islands of the parenchyma.

3. Portal Cirrhosis with Secondary Parenchymatous Hypertrophy. —The hypertrophic, alcoholic cirrhosis of French writers. The organ larger than, but similar in character to, the preceding form. There is a considerable amount of confusion about this form, owing to the use of the term "hypertrophic." It has often been confused with the biliary cirrhosis of the type studied more especially by Hanot; while, again, others confound with this the intermediate stage between the enlarged fatty cirrhotic liver and the small

atrophic organ, and again cases of mixed biliary and portal cirrhosis. In the true hypertrophic cirrhosis of this type the organ presents a nodular surface, some of the nodules being of a relatively-large size. The weight is normal or above the normal, and the enlarged size appears to be due, in the main, to compensatory overgrowth of some of the isolated lobular masses and to a partial recovery of the organ from the effect of the cirrhosis.

4. Portal Cirrhosis with Adenomatous or Adenocarcinomatous Overgrowth.—The distinction between the last condition of cirrhosis with parenchymatous hypertrophy and cirrhosis with generalized adenomatous condition is very subtle, and, as shown in connection with Fussell and Kelly's first case (Trans. Assoc. Amer. Physic., vol. x, p. 116, '95), good authorities may differ as to whether a liver presents the one or the other condition. On the other hand, there may be such extensive overgrowth and multiple formation of large neoplastic masses, that there can be no doubt as to the cancerous nature.

> [Kelch and Kiener (Arch. der Physiol., p. 622, '76), who first called attention to the condition, regarded the cirrhosis as secondary to the overgrowth. In this probably they are in error. Several examples of this adenomatous condition, and of the carcinomatous, have been described by Paul (Trans. Path. Soc., London, xxxvi, p. 238, '85), Hanot and Gilbert (Etudes sur les Malades du Foie, '88), Adami and Finley, Fussell and Kelly, Rohwetter, Saburin, Kelynack (Edinburgh Med. Jour., p. 187, '97), and others. J. George Adami.]

In the majority of these cases the cirrhosis seems to be of the mixed kind, being multilobular and at the same time presenting abundant formation of new bile-canaliculi: an indication that possibly the following form is not truly a mixed portal and biliary cirrhosis, but a portal cirrhosis with parenchymatous hypertrophy, one of the indications of their hypertrophy being a proliferation of the bile-canaliculi.

5. Mixed Cirrhosis.—A very large number of cases must anatomically be classed under the heading of mixed cirrhosis, though the gross appearance of the organ and the clinical history bring them definitely into the category of portal cirrhosis. The condition is, in the main, multilobular, but there is abundant formation of new bile-canaliculi. The organ, again, in general, approximates to the normal size, and there is not the extreme atrophy seen in the uncomplicated cirrhosis.

6. Portal Cirrhosis with Pigmentation.—It is well known that normally the liver contains a certain amount of iron. Lindemann (Ctbl. f. Allgem. Pathol., vol. viii, '97) finds that this iron in the slightest grades exists only in the cells of the portal tissue; when more extensive, there is deposit of the iron-pigment in the capillary-walls, and Kupffer's cells are affected; in the highest grade of anæmia the pigment is in the liver-cells at the periphery of the acini. This pigment is, in general, of a brownish or ochrous tint, and, though Auscher and Lapicque (Soc. Méd. des Hôp., Feb. 12, '97) speak of it as a form of hydrated iron, it is, perhaps, more truly an iron albuminate. Within the last few years, Letulle, Hanot and Schuhmann, Gilbert, and Grenet have described several cases of pigmentary cirrhosis, occurring in general in association with the hypertrophic type of the disease: *i.e.*, with either mixed cirrhosis or portal cirrhosis with parenchymatous hypertrophy. In these cases the livers contain increased amounts of iron. In a recent case of this nature observed by me the liver was of normal weight, but diminished in size

and markedly atrophic, showing this iron everywhere, not only in the portal spaces, but present in large amounts in the cells right to the very centre of the hepatic lobules. The Germans are inclined to consider these cases as examples of cirrhosis complicated with the condition which von Recklinghausen has denominated "hæmochromatosis": a condition of which a full account will be found in Hintze's paper (Virchow's Archiv, vol. cxxxix, p. 459). Two out of five of Hintze's cases of this condition showed cirrhosis of the liver.

In these states the iron-pigment is not only present in the liver, but is abundant more especially in the non-striated muscle, more especially in the intestines, in the lymphatic glands, and it may be also in the pancreas, spleen, salivary glands, etc. Lubarsch (*ibid.*, p. 495) ascribes this condition either to secondary results of large hæmorrhages or to the development of multiple capillary hæmorrhages whereby the iron of the hæmoglobin is taken up and deposited in this modified form into the various organs. Possibly there is an intimate connection between the occurrence of multiple small hæmorrhages in the portal area and the production of this pigmented cirrhosis; rarely the skin also becomes pigmented and shows a bluish color.

[Bronzed diabetes. In association with diabetes there also occurs, rarely, a combination of pigmentation and bronzing of the skin, and cirrhosis of the liver of the "mixed" portal type. The cases of this *diabète bronzé* have been noted almost exclusively in France, though Saundby, in England, has recorded one case. In many cases of diabetes, more especially in the early stage, the liver is found enlarged; Saundby, indeed, concludes that it is generally enlarged, weighing from 50 to 60 ounces. The enlargement is, in the main, due to chronic congestion, but a small amount of interstitial hepatitis is frequently present, and occasionally this is so extensive as to produce distinct cirrhosis. In such cases the liver is sometimes smooth, at other times it is found granular and scarred. Brault and Gillard are of the opinion that the new growth begins in both the hepatic and portal areas, by which I infer that they would indicate that the process is of the mixed type. The accounts given in the French journals are, in general, so meagre, that it is difficult to arrive at any satisfactory conclusions as to the intimate nature of the pigmentation which has, at times, been found to accompany this cirrhosis. (For another form of pigmental cirrhosis, the "cirrhosis arthracotica" of Welch, see later under SPORADIC CIRRHOSIS.) J. GEORGE ADAMI.]

7. CIRRHOSIS WITH CALCIFICATION.—I am acquainted with only one well-marked example of this condition, described by Taggert (Trans. Path. Soc. London, '89), in which the deposit of calcareous matter in the cirrhosed liver was so extensive that a saw had to be used in order to make sections of the organ.

Symptoms.—The condition of portal cirrhosis begins insidiously and may continue to an extreme condition without producing any symptoms which call attention to the existence of the process. Very frequently the earliest symptoms are associated with the alimentary tract; next in order are evidences of portal obstruction, and only when the condition is very well marked may there be disturbances referable to the hepatic function. Whether the gastric and intestinal disturbances are primary or secondary is a matter concerning which there has been debate. That they are not entirely due to the overfilling of the gastric and intestinal vessels in consequence of the portal obstruction is, I think, evident from the fact that they appear long before any signs of such obstruction show

themselves, and if we ascribe alcoholic cirrhosis not so much to the alcohol itself as to the pathological condition of the stomach and intestines whereby toxic substances are absorbed from the food, then we must regard this as being the earliest disturbance in the course of the disease. That at a later period the abdominal congestion further militates against the proper performance of the gastric and intestinal functions there can be no doubt. It would be well, therefore, to subdivide the symptoms into:—

1. The disturbances occurring in connection with the alimentary tract.

2. Symptoms of vascular obstruction.

3. Symptoms referable to disordered function of the liver and to altered metabolism.

Symptoms Referable to Gastric and Intestinal Disturbance. — Of these the most noticeable are: at the very earliest stage slight dyspepsia, morning vomiting or nausea, and furred tongue; added to this there may be eructations and irregularity of the bowels. There is often an alternation of constipation and catarrhal diarrhœa. During the former of these the stools often present remarkable modifications: some days they are normal, then they become very dry and are covered with a thick layer of mucus; at other times they are colorless, and, as Graves has pointed out, in the same stool one may find portions which are gray, clayey, and others of normal color. To these disturbances of the digestive system may be largely attributed the emaciation of the later stages of the disease.

Symptoms Referable to Disturbances of the Circulation.—So long as there is a well-established collateral circulation, for so long will there be no symptoms referable to obstruction. It is only when this collateral circulation becomes inadequate to carry the portal blood to the heart that ascites and other obstructive disturbances supervene. Thus, not infrequently we meet with extensive portal cirrhosis without a sign of ascites. Very frequently, however, the nature of this collateral circulation is the direct cause of death; more especially is this the case with the plexus of submucous veins at the lower end of the œsophagus which plays a prominent part in this collateral circulation. These veins, being practically unsupported toward the free surface of the œsophagus, become varicosed and relatively enormous; the patient may appear in very fair health and the liver be performing its functions satisfactorily with but a thirty-second of an inch or less intervening between life and death; for it is these varicosed subœsophageal veins which are especially liable to rupture and to produce so extreme a hæmorrhage that death follows in the course of a few hours.

The best account of this collateral circulation is given by Osler and we here recapitulate it:—

"The compensatory circulation is usually readily demonstrated. It is carried out by the following set of vessels: 1. The accessory portal system of Sappey, of which important branches pass in the round and suspensory ligaments and unite with the epigastric and mammary systems. These vessels are numerous and small. Occasionally a large single vein, which may attain the size of the little finger, passes from the hilus of the liver in the round ligament and joins the epigastric veins at the navel. Although this has the position of the umbilical vein, it is usually, as Sappey showed, a para-umbilical vein; that is, an enlarged vein by the side of the obliterated umbilical vessel. There may be produced about the navel a large bunch of varices: the so-called caput Medusæ. Other

branches of this system occur in the gastro-epiploic omentum, about the gall-bladder, and, most important of all, in the suspensory ligament. These latter form large branches, which anastomose freely with the diaphragmatic veins, and so unite with the vena azygos. 2. By the anastomosis between the œsophageal and gastric veins. The veins at the lower end of the œsophagus may be enormously enlarged, producing varices which project on the mucous membrane. 3. The communications between the hæmorrhoidal and the inferior mesenteric veins. The freedom of communication in this direction is very variable, and in some instances the hæmorrhoidal veins are not much enlarged. 4. The veins of Retzius, which unite the radicles of the portal branches in the intestines and mesentery with the inferior vena cava and its branches. To this system belong the whole group of retroperitoneal veins, which are, in most instances, enormously enlarged, particularly about the kidneys, and which serve to carry off a considerable proportion of the blood."

But in addition to the disturbance in the portal circulation, there appears to be also a frequent accompanying disturbance in the general circulation. It may here be more correct—inasmuch as this disturbance seems to be largely associated with alterations in the blood brought about by the hepatic disturbance—to refer to this under a later heading.

> Case of alcoholic cirrhosis in which there were present enlargement of the liver, dilatation of the subcutaneous abdominal veins and ascites (necessitating four punctures in the course of a year). Small, erectile, venous tumors appeared on the face, in the pharynx, and on the internal surface of the last phalanx of the ring-finger of the left hand. The latter became the source of a quite-active hæmorrhage. Bouchard (Marseille-méd., Oct. 15, '91).

Ascites.—The ascites of portal cirrhosis develops gradually, and in this way is to be distinguished from that following thrombosis of the portal vein. While it is a very prominent and characteristic symptom of the condition, it must be remembered that it is far from being constantly present. Indeed, I may go further and point out that much of the failure of clinicians to recognize portal cirrhosis is due to the erroneous belief that ascites almost constantly develops. *It does not by any means*; only in advanced atrophic cases is it the rule. The older writers speak of it as being present in about 80 per cent. of the cases; more recent careful observers give a lower proportion, thus: Rolleston and Fenton (Birmingham Med. Review, Oct., '96) find, from the post-mortem records at St. George's Hospital in London, that of 114 cases only 36, or a little over 30 per cent., showed ascites. Kelynack in 121 examples (*ibid.*, Feb., '97) of common hepatic cirrhosis, as he terms it, coming to the post-mortem room at the Manchester Royal Infirmary, found ascites in 56 per cent.

With reference to these figures, it must be remembered that these are statistics, not of cases of portal cirrhosis recognized as portal cirrhosis during life, but in the post-mortem room, and this will explain the low percentage here given. Nevertheless they show very clearly that ascites is not the frequent and necessary accompaniment that is generally held. The fluid in these cases is clear, but may be slightly bile-stained; after repeated tapping it assumes more the character of an inflammatory exudate. According to some French observers, it begins as a subacute peritonitis; this is, however, doubtful. The fluid is alkaline, with a specific gravity varying between 1010 and 1015, though, if there has been any

peritonitis, this specific gravity and the percentage of proteid are increased and the fluid may show spontaneous coagulation. Hale White, in his article on "Perihepatitis" (Allbutt's "System of Medicine"), holds that ascites proper is a late event in cirrhosis, for which more than one tapping is rarely required, and regards those cases in which multiple tappings are necessary as being complicated with peritonitis; indeed, he goes so far as to hold that, where ascites is directly due to cirrhosis and paracentesis is necessitated, the patient rarely lives long enough after the first tapping for the second to be necessary. Of 10 cases which were recorded during life as having cirrhosis, but were tapped oftener than once, of 4 at post-mortem examination, 3 were found to be cases of chronic peritonitis and perihepatitis and 1 of colloid disease of the peritoneum; the remaining 6 had more or less chronic peritonitis associated with the cirrhosis which was present. In fact, he would employ this as of diagnostic value as between uncomplicated cirrhosis and peritonitis or perihepatitis with or without cirrhosis.

Literature of '96 and '97.

Form of cirrhosis of the liver consequent upon the circulatory obstruction due to pericardial lesions. There is, at times, a clinical difficulty as to whether an hepatic enlargement with more or less ascites is a primary or secondary disease, especially where there are obvious physical signs of a valvular lesion and hardly any of back-pressure. Three cases of this form of pseudocirrhosis witnessed. Pick (Zeit. f. klin. Med., B. 29, H. 5, 6, '96).

Œdema of the feet is not infrequently secondary to ascites, and is, in the main, due to a pressure of the distended abdominal contents upon the veins coming from the lower extremities. According to Osler, œdema of the feet may precede the development of the ascites, in which case it is to be ascribed to the malnutrition of the patient and the impoverished condition of the blood. The dropsy rarely becomes general.

Enlargement of the Spleen.—This is far more frequent than is ascites. Thierfelder found, out of 172 cases, only 39, or 22 to 23 per cent., in which this symptom was absent; indeed, it may be regarded as the most common of the symptoms associated with portal cirrhosis. Oestreich is inclined to believe that this enlargement of the spleen is not entirely due to portal obstruction, in that it appears at so early a stage of the condition before other marked signs of such obstruction are evident; indeed, it is suggested that the toxic causes which are at work to produce the hepatic lesion bring about enlargement of the spleen.

Literature of '96 and '97.

If passive congestion be the cause of splenic enlargement, why is the spleen so frequently small and hard in cases of chronic passive congestion of the abdominal viscera due to heart disease? F. P. Weber (Edin. Med. Jour., N. S., vol. ii, p. 579, '97).

The average weight in the spleen in hepatic cirrhosis is 12.93 ounces, while in cardiac cases it averages only 7.32 ounces. Again, the greatest enlargement of the spleen is not found where the portal obstruction is greatest, but in those cases of portal cirrhosis where ascites is delayed till the last or is wholly absent. Kelynack (Edin. Med. Jour., N. S., vol. ii, p. 579, '97).

Weber, like Oestreich, is of the opinion that toxæmia is the cause of the enlargement. The organ is enlarged from one-half to three times its normal size; in one case of portal cirrhosis which recently came under my notice, it weighed 720 grammes. Describing a similar case of large splenic tumor, Banti compares

it with the malarial spleen, and urges the probable infectious origin of such cases.

Literature of '96 and '97.

Case of splenomegaly followed by hepatic cirrhosis in a middle-aged woman. There was no history of malaria or syphilis, but she had suffered for many years from pellagra. There had been no abuse of alcohol. Bonardi (Gazz. degli Osped., Jan. 3, '97).

Case of hypertrophic cirrhosis of the liver in a boy 9 years old. At the autopsy the liver was found to weigh 650 grammes, had a yellowish-green color and an irregular surface; a large number of fibrous bands traversed the organ, the bile-ducts were dilated, the spleen hard. Dellemagne and Tordens (Jour. de Clin. et de Thérap. Inf., vol. v, No. 17, '97).

Hæmorrhoids. — While hæmorrhoids are frequent in cases of portal cirrhosis, the majority of recent writers are of the opinion that they are far from being as common as used to be taught.

Pain and Tenderness over the Region of the Liver.—This latter is often most noticeable in the early stages, and is often accompanied by a sense of epigastric fullness and tension, which may be present through the duration of the disease. As Ross pointed out and explained in his remarkable article in the tenth volume of Brain, besides these sensations referred directly to the diseased organ (or conditions of *splanchnic* pain), there may be other painful sensations which may be termed *somatic,* or referred pains. The liver is innervated from the seventh to the tenth dorsal, and, as a consequence, the pain affecting the organ may be referred to the cutaneous branches of these nerves by overflow of irritation in the cord, and, as a matter of fact, pain is frequently felt in the region of the angle of the right scapula. Another pain at times experienced is that at the tip of the right shoulder, more rarely of both shoulders. Where this is the case there is an indication of involvement of the upper surface of the organ, extending to the diaphragm, for such pain is brought about by the overflow of irritation at the point of entry of the phrenic nerve into the spinal cord; and so there is reference to pain along the branches of the lower cervical nerves, the phrenic arising chiefly from the fourth cervical with a few filaments from the third.

Symptoms Referable to Disturbed Function.—*Jaundice.*—One of the most constant symptoms of portal cirrhosis is a slight icteroid tinge of the conjunctivæ accompanied by a bright, watery appearance of the eyes. The skin, in general, save where there is frank development of ascites, is pale rather than icteroid, but as the disease progresses the face gains a sallow, ashy tinge. In the very rare extreme cases of pigmentary cirrhosis the skin may assume a slaty-blue or in some cases, as in diabetic cirrhosis, a bronzed appearance similar to that seen in Addison's disease.

Jaundice, however, may show itself in any period of the disease; it is characterized by not presenting that continuous and progressive severity observable in cases of true biliary cirrhosis. According to Fagge, at Guy's Hospital, out of 130 cases, only 35 showed this symptom, or just under 27 per cent., and, according to Price (quoted by Graham), the proportion is lower, namely: 17.5 per cent.

Urine.—In the earlier stages there may be little or no change, but, as the condition progresses, the quantity diminishes in amount, the color becomes dark, and, as Hayem and von Jaksch have pointed out, the greatly-increased amount of urobilin is an indication of considerable value where the diagnosis is doubtful. Save where there is a frank condition of

jaundice, bile-pigments are absent. The urea is often found diminished; the urates, on the other hand, markedly increased. Albumin is, at times, present, with casts, apart from those casts which may be associated with jaundice. Kelynack found renal cirrhosis present in a little over 18 $^1/_2$ per cent. of his cases.

The carbohydrates in cases of cirrhosis of the liver are not excreted as sugars by the kidneys, although they are found as such in the serous exudates in the pleural and abdominal cavities. Colasanti (Riforma Medica, Mar. 27, '91).

Study of the urine in cirrhosis of the liver; conclusions: 1. The quantity of urea eliminated in twenty-four hours is much diminished, but presents variations from day to day. 2. Milk diet augments the elimination of urea and favors diuresis. 3. With the diminution of the elimination of urea, that of ammonia increases; with a milk diet this is reversed. 4. The chlorides keep pace with the urea. 5. Oxidized urochrome and urobilin are diminished during a milk regimen. Ajello and Solaro (Il Morgagni, Feb., '93).

Literature of '96 and '97.

Case of a patient in whom cirrhosis of the liver was combined with diabetes mellitus. He was under observation for nearly eight and a half years. The first symptom to appear was slight jaundice, followed some months afterward by certain diabetic symptoms, namely: thirst, and sugar in the urine, to the amount of 1½ to 2 per cent. This yielded to appropriate treatment, but five years afterward ascites appeared, along with slight jaundice, enlargement of the liver and spleen, and some dropsy of the feet, etc. At the necropsy, marked cirrhosis of the liver, with enlargement of the spleen and kidneys, as well as tubercular deposits (both old and recent), were found. Hepatic cirrhosis in such cases is of a special kind and holds an intermediate position; it is characterized by marked increase in the size of the liver and spleen, with but little tendency to contraction on the part of the former, and also by the presence of pigmentation in the skin. Pusinelli (Berl. klin. Woch., No. 33, '96).

The Blood.—There is very little that is characteristic about the condition of the blood in portal cirrhosis. There is no marked increase in leucocytes, no extensive diminution either of the hæmoglobin or of the number of red blood-corpuscles, but the tendency toward epistaxis and the development of petechiæ in connection with the general, as opposed to the portal, circulation would seem to indicate that either the blood is of such a poor quality or contains such abnormal and toxic substances as to lead to degeneration of the capillary walls, and, as already pointed out, the occasional occurrence of œdema preceding ascites is another indication of this toxic or impoverished condition of this fluid. While the hospital is of such relatively-recent establishment, and the number of cases of portal cirrhosis in post-mortem records too few to establish definite statement, I have been struck by the frequency with which, during life, the clinical records at the Royal Victoria Hospital, Montreal, note an apical systolic murmur, recognized as functional, the post-mortem confirming its functional nature.

A further indication of the altered or thinned condition of the blood is the not-infrequent existence of a venous hum in the epigastric region noted by several recent observers and of a splenic souffle first noted by Bouchard.

Other Symptoms Referable to Disturbed Hepatic Function.—Very characteristic toward the latter stage are certain nervous symptoms, which also are, in general, attributed to a toxic condition of the blood. These are, by some, classed as manifestations of cholæmia, although, as they may be present when there is no evi-

dence of the passage of bile into the blood, this use of the term is scarcely exact. I refer to the drowsiness of many patients and the more marked nervous conditions of coma and delirium. Where death is not due to hæmorrhage or intercurrent disease, such as tuberculosis, it is these nervous disturbances which are the prominent feature in the fatal event. These nervous symptoms may be mistaken for the onset of uræmia. There may be marked excitation, or, on the other hand, a progressive and deepening stupor passing into complete coma.

Literature of '96 and '97.

Case of hæmorrhage from the larynx in the course of alcoholic cirrhosis. Hæmatemesis and epistaxis also occurred. Laryngeal hæmorrhage ascribed to the interference with the hæmatopoietic functions of the liver by the atrophic cirrhosis of that organ. Lubet Barbou (Archives de Laryn., July, Aug., '97).

Differential Diagnosis.—The preceding pages will have given in fairly full detail the main features characterizing the different forms of hepatic cirrhosis. Here, however, it may be worth while to point out again that there are four forms of hepatic cirrhosis, or of conditions clinically regarded as cirrhosis, between which we have to distinguish, namely: portal cirrhosis proper, biliary cirrhosis, chronic perihepatitis, and gummatous syphilis of the liver. All other forms, with the exception of the pericellular syphilitic cirrhosis of the infant, are clinically unrecognizable.

Leaving aside, for the moment, the most important of these,—namely, portal cirrhosis,—the main features whereby the biliary form of the disease is to be differentiated are the progressive icterus, the enlargement of the organ, the absence of marked digestive disturbances, the long continuance of the condition, and the retention of appetite and strength. The coloration of the stools by bile and the more extensive enlargement of the organ must be the main factors in diagnosing between what we may term the catarrhal form of biliary cirrhosis and the very rare purely-obstructive form.

Gummatous syphilis is only likely to be confounded with portal cirrhosis when, through obstruction to the portal circulation, ascites supervenes. Under these conditions the organ may be either of normal size or greatly contracted by a multitude of syphilitic cicatrices. In the former case the coarse lobulation of the organ is more likely to lead to the diagnosis of cancer of the organ than of portal cirrhosis; in the latter case the signs and symptoms may be so closely allied to those of portal cirrhosis as to render diagnosis a matter of extreme difficulty. The presence of syphilitic lesions elsewhere, and the history of the case, may help toward the diagnosis, which will be finally determined by the effects of antisyphilitic treatment.

Generalized fibroid perihepatitis may, with great difficulty, be distinguishable from true portal cirrhosis. If the organ can be felt, the rounded character of the edge, the absence of roughness of fine nodulation on palpation, the presence of a thickened omental mass below the liver, all are in favor of a diagnosis of perihepatitis. As already stated, according to Hale White, if a patient is able to stand a long series of tappings of the ascitic fluid, the diagnosis is against the existence of an uncomplicated portal cirrhosis, and is in favor either of chronic peritonitis associated with perihepatitis or of portal cirrhosis complicated by chronic peritonitis.

The main points elicited in the preceding pages with regard to portal cir-

rhosis and its diagnosis are the following:—

1. That the small size of the organ is by no means the main diagnostic feature of this condition. Only in advanced cases, and by no means always then, is the organ markedly atrophied. Of far greater diagnostic importance is the determination of progressive diminution in size of the organ.

2. If the organ be palpable, the recognition of a finely-nodular, firm surface indicates with relative certainty the existence of this condition.

3. Contrary to general opinion, in only about 50 per cent. of the cases in which the autopsy reveals a well-developed condition of portal cirrhosis is there ascites.

4. Enlargement of the spleen is a much commoner symptom, and this is present in more than 80 per cent. of the cases.

5. Jaundice is present in about 30 per cent. of cases. Such jaundice tends to be transient and to develop after other symptoms have been present some little time.

6. From the very onset of the condition gastric and intestinal disturbances form a prominent feature in the disease.

7. The progressive emaciation and weakness are also characteristic, and with this may be associated a peculiar, sallow, slightly-earthy complexion.

8. A urine free from sediment (mainly of urates) is against the diagnosis of cirrhosis; while the presence of increased quantities of urobilin is, in the presence of other symptoms, in favor of such a diagnosis.

Of other conditions affecting the liver which may be confounded with cirrhosis are to be mentioned cancer, thrombosis of the portal vein, senile or marantic atrophy of the liver, and cyanotic induration.

Of these, PORTAL THROMBOSIS may occur as a complication of cirrhosis. Where this occurs in the absence of cirrhosis the main distinguishing feature is the rapid development of the ascites and its rapid return after tapping. At the same time, such thrombosis is secondary to disease of other abdominal organs, more frequently of the intestinal tract, and the symptoms proper to such disease will have preceded the development of ascites.

CANCER OF THE LIVER is characterized by the increase in size of the organ, the presence of large nodules presenting umbilication, the absence of splenic enlargement, the cancerous facies, and, in general, the presence of cancerous nodules elsewhere. Those cases in which cancer of the organ is present without the development of nodules upon the anterior surface of either lobe at times cause very great difficulty. Here the small size of the spleen, the character of the urine, the complexion, and other signs and symptoms, which ordinarily are regarded as of secondary importance, become of the highest value in diagnosis.

> Attention called to the occasional resemblance between hypertrophic cirrhosis and hepatic carcinoma, and stress laid upon the difference in the stools, which are bilious in the former, clay-colored in the latter. Freyhan (Deutsche med.-Zeit., May 8, '93).

In cases of SENILE, or MARANTIC, ATROPHY the organ, if it can be palpated, is smooth; there is absence of ascites and of jaundice.

The ATROPHIC NUTMEG LIVER (cyanotic induration) and also the "hypertrophied" nutmeg liver are also characterized by the smooth surface of the organ, as also by the prominent symptoms of obstructive disease of the heart.

Other forms of ascites and peritonitis are not infrequently mistaken for the results of cirrhosis; indeed, I think it

may be said with confidence that the most frequent cause of false diagnosis of cirrhosis, is either CANCEROUS or TUBERCULAR PERITONITIS. In such cases there may be present gastric and intestinal disturbances easily mistaken for those accompanying cirrhosis; the ascites may be of gradual development, as in portal cirrhosis; and the liver, being, by the accumulation of fluid, forced upward, may disappear behind the ribs and so be diagnosed as presenting great atrophy. Between cancerous and tubercular peritonitis the distinction may be drawn that in the former the spleen is not enlarged, and in the latter the enlargement may be as extensive as in portal cirrhosis. In these cases, again, it is the secondary symptoms and signs which are of the greatest value in arriving at a decision: complexion, urine, etc., and, in addition to these, the character of the abdominal fluid when removed. Most important, also are manifestations of disease elsewhere, either cancerous or tubercular. In cases of doubt, to determine the tuberculous nature of the condition, it is well to inoculate a rabbit or guinea-pig, and, for the recognition of cancer, to make a careful search for cancer-cells in the removed fluid.

Complications.—Leaving out of account the rare cases of development of a primary adenomatous or cancerous condition, there may be other complicating conditions in the liver itself of the nature of degenerative changes; in advanced cases it is not infrequent to meet with evidence of fatty degeneration of the cells as distinct from the fatty infiltration seen in less advanced conditions; more rarely is amyloid degeneration present. Thrombosis of the portal vein occurs occasionally.

TUBERCULOSIS.—The most frequent complication outside the liver is the development of tuberculosis. Rolleston and Fenton find pulmonary tuberculosis in 32 out of 114 cases, tuberculosis being the direct cause of death in 17. Kelynack, out of 121 cases, finds tuberculosis either active, latent, or obsolete in 28: *i.e.*, 23 per cent. Of these 28, in 14 the condition was active in the lungs, in 12 in the peritoneum, and in 7 both in the lungs and peritoneum. Twelve, or about 10 per cent., of the cases died directly from tuberculosis; in 8 per cent. the condition was latent or obsolete.

> Tuberculosis is a cause of cirrhosis of the liver. The liver becomes generally atrophied, indurated, and granular, like the cirrhosis which results from the abuse of alcohol, although in a less degree. More rarely, it becomes deeply furrowed and lobulated, as in syphilitic cirrhosis. Hanot and Gilbert (La Sem. Méd., Feb. 3, '92).
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> A case of infectious cirrhosis of the liver, of unknown origin, in a rabbit that had been inoculated with a fragment of epithelioma of the kidney. Tuberculosis was not found in other organs, and tubercle bacilli could not be found in the hepatic lesions. Psorosperms were likewise absent. The histological appearances were unique, and indicated that the infection had spread from the centre to the periphery. Pilliet (Bull. de la Soc. Anat., No. 17, '93).

Other frequent complications are: RIGHT-SIDED PLEURISY with a serous or sero-sanguineous exudation. This condition has not, as yet, been thoroughly worked out; so far as I can see it is not of a tuberculous nature, for I have come across cases showing such pleurisy in which there has not been a sign of tuberculosis at the post-mortem. Where it is present I have also noted a co-existence of adhesions between the upper surface of the liver and the diaphragm, which might indicate an extension of the inflammatory process from the liver to the pleural cavity. Were this so, it would

be evidence in favor of microbic origin or microbic complication in the hepatic condition; but, as already stated, this subject requires much further study; occasionally there is evidence of bilateral pleurisy.

> Pleuritic effusion on the right side only, in Laennec's, generally considered as an exceptional symptom is, however, a constant symptom. Found in nine cases of cirrhosis. It is of value in the diagnosis of doubtful cases, when it is difficult to determine whether ascites is due to cirrhosis of the liver, to thrombosis of the portal vein, or to compression of that vessel by tumors or swelled glands. G. Villani (Riforma Medica, Mar. 9, '95).

Another frequent complication is NEPHRITIS, either of the granular type or not infrequently as a mixed interstitial nephritis, of what Formad has termed the "hog-backed" type, the organ being enlarged, more especially from before backward, and showing microscopically a condition of mixed interstitial and parenchymatous nephritis. The interstitial type is, in general, associated with evidences of some degree of general arteriosclerosis and with other complications due to this process. Both the interstitial and the hog-backed kidney are, it need scarcely be said, characteristic of alcoholism. The statistics of the various authorities with regard to the frequency of renal complications are not sufficiently extensive to arrive at any very satisfactory conclusion. G. Foerster, in his 31 cases recorded at Berlin, found nephritis 3 times, granular atrophy 4 times, and "indurated" kidney 4 times. Kelynack found renal cirrhosis in a little over $18^1/_2$ per cent. of his cases. Gärtner found 11 out of 12 to show "chronic nephritis"; 10 of these were habitual drinkers of brandy.

Other alcoholic complications may also be present, notably some extent of chronic pachymeningitis and thickening of the dura mater, and fatty degeneration of the heart-muscle.

Lastly there is a liability for acute inflammatory processes to supervene: pneumonia, acute bronchitis and pericarditis, erysipelas of the œdematous skin, and acute peritonitis; this last often secondary to paracentesis.

Prognosis.—The condition begins so insidiously that it is difficult to make an accurate statement concerning its duration. It will be generally agreed that Fitz is not too hopeful in stating that the fatal result may be expected within a year after hæmorrhage or other sign of portal obstruction. Von Kahlden instances a case (Münch. med. Woch., 48, '97) of a very acute development of the disease in which death occurred three and a half months after the first symptoms presented themselves. The form of cirrhosis in this was of a mixed type. If the cases of Carrington and Cayley are to be regarded also as examples of portal cirrhosis, we have further evidence that the disease may be fatal in three months after the first occurrence of dyspepsia and of epigastric fullness, or two months after the first onset of ascites. At the other extreme, we come across many cases, in the post-mortem room, of well-developed portal cirrhosis which had given rise to no symptoms during life. Thus, clearly the condition may be present in a latent or it may be in an arrested form for months and it may be for years. It is difficult to explain otherwise a case such as that of Taggert's, in which the cirrhotic tissue had undergone calcification. It is difficult, also, to know how to regard those cases in which, cirrhosis being diagnosed, after one or two tappings the symptoms disappear and the patients apparently recover, because these cases may have been conditions, not of

true cirrhosis, but of subacute perihepatitis. If, by palpation and by other physical signs and symptoms, and more especially by the character of the urine, it is determined that portal cirrhosis is present, prognosis is very bad.

Both Rolleston and Kelynack agree that a little under half the cases die directly from the effects of hepatic cirrhosis, though it is a little doubtful what effects they include under this term.

Treatment.—There is no treatment known save the palliative, and it is, indeed, difficult to see how to arrest the condition once there is marked development of this contracting, fibrous tissue in the organ. The avoidance of alcohol, spices, coffee, and other irritant substances; avoidance of fatigue and of cold, together with maintenance of regular action of the bowels by mild aperients are all indicated. Several authorities have recommended a milk diet, but, according to Jaccoud and others, it has absolutely no effect in arresting the progress of the disease.

> Importance of treatment during the initial stage of cirrhosis. The course of the hepatic affection is thus retarded and the danger of the numerous infectious processes, to which patients with hepatic cirrhosis are predisposed, is lessened. This consists in modifying as much as possible the arthritic condition in which cirrhosis develops in the majority of cases; in interdicting the use of alcoholic drinks, in correcting the noxious effects already produced by them in the organism; in effecting the intestinal antisepsis made necessary by the deficiency in the antitoxic function of the liver. Hanot (La Sem. Méd., Feb. 21, '94).

Some more recent writers recommend massage as improving the general condition of the patient. The treatment which affords most relief would appear to be the employment of alkaline mineral waters and saline purgatives, whereby some relief is given to the congestion of the portal system.

> A case of hypertrophic cirrhosis of the liver, with jaundice of nine months' duration, in a man aged 30 years, cured by calomel, ⅞ grain being given 6 times daily for 3 days, and repeated after an interval of 3 days. Sior (Berliner klin. Woch., Dec. 26, '92).
>
> Four cases of cirrhosis of the liver of alcoholic origin and one due to paludism, in which cures were obtained by the administration of the iodides and mercury, the latter in the form of blue pill, together with diuretic medicaments. Ferreira (Bull. Gén. de Thér., Oct. 30, '92).

Where ascites is present, tapping gives great relief, and, as pointed out by Murchison and recommended by Graham in his admirable article in the Loomis-Thompson "System of Practical Medicine," after this tapping digitalis and diuretics are both effectual and useful.

> Japanese physicians obtain excellent results from the use of potassium bitartrate, 2 to 10 drachms per day, combined with tonics, in ascites due to cirrhosis of the liver. Sasaki (Berl. klin. Woch., No. 47, '92).
>
> Two cases of cirrhosis apparently checked by tapping. One case presented a clear history of abuse of alcohol; in the other this was probable. In both the liver was enlarged. Lauenstein (Deutsche med. Woch., Nov. 19, '95).

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> Special attention drawn to the value of urea as a diuretic. Two and a half drachms given in the day, increased up to 5 drachms, continued for 2 or 3 weeks. No unfavorable effects witnessed. The unpleasant taste may be done away with by drinking milk immediately after taking it. G. Klemperer (Berl. klin. Woch., Jan. 6, '96).

After hæmorrhage from the œsophagus of the stomach, ice should be taken internally and morphine may be given.

The operation of bleeding has so fallen

into disuse that scarce any authority recommends this as a means of rapidly relieving the congestion. Personally I have been struck at autopsies by the amount of blood still present in the organs even when profuse hæmorrhage has been the cause of death; and it seems worth while to suggest that, where other means fail, the removal of blood from the general circulation, by temporarily lowering the general blood-pressure, is capable of aiding the more rapid flow of blood from the congested portal circulation into the inferior vena cava and vena azygos, and so is capable of aiding the development of a more satisfactory collateral circulation.

Biliary Cirrhosis.

Under the term "biliary cirrhosis" two distinct conditions are to be included:—

1. A condition rare, clinically, but produced experimentally in the lower animals by Charcot and Gombault by ligature of the common bile-duct. A condition in which obstruction of the larger bile-ducts is followed by inflammatory condition of the intrahepatic and extrahepatic bile-ducts, and the later development of fibrous tissue around them.

2. A condition in which the liver is found permanently enlarged, with the development of much rather loose and non-contracting fibrous tissue, in which, as evidenced by the accompanying jaundice, there is some hindrance to the free flow of bile through the smaller ducts, for no obstruction of the extrahepatic bile-ducts is to be recognized.

A further characteristic of this form is the peculiar extensive development of the already-described new bile-ducts in the hyperplastic fibrous tissue.

1. Obstructive Cirrhosis.

Definition.—The cirrhosis of obstruction of the large bile-ducts.

It may be laid down as a rule that the simple obstruction of excretory passages leads, not to fibrosis, but to distension and atrophy of the cells and tissues bordering upon the ducts, and, as a matter of fact, the majority of cases of long-continued biliary obstruction from gall-stones or from pressure upon the common bile-duct is accompanied by no obvious increased development of fibrous tissue in the organ. Certain rare cases, however, do occur where there is a very characteristic increase in the connective tissue around the bile-ducts in the liver. Why this should be so it is difficult to explain, unless there be some cause over and above the simple obstruction. What this cause is is impossible to say, because in some of the best-marked early cases—as, for example, one of Kanthack and Rolleston and another of Heneage Gibbes—the condition shows itself in children which have died at such an early age that the condition must be regarded as congenital. Possibly some constituent of the excreted bile acts in these cases as an irritant.

[Well-marked cases of this type of cirrhosis in the adult are distinctly rare. That of Kelch (Revue de Méd., p. 969, '81) would seem to be the first surely of this nature. Goluboff's case (Zeit. f. klin. Med., vol. xxiv, '94), while referred to a chronic and intermittent gall-stone obstruction, dating back for 11 years, was anatomically found to be of the type to be immediately dealt with. It is only to be expected that the one form should pass into the others. One of the best descriptions of the condition is given by Giggs (Trans. Path. Soc., London, vol. xxxiv, p. 129, '83). A male infant began to show slight-yellowish tingeing of the skin and jaundice a few days after birth. The jaundice persisted, but was never very deep in color. Nutrition was maintained until the sixth month, when wasting and ascites supervened, the child dying during the next month. The liver in

this case was hard and smooth; there was no trace of the common duct; the hepatic duct close to this organ was filled by a fibrous mass; the portal vein was normal. With these appearances it is difficult to comprehend why the jaundice was not of the severest type. Microscopically there was enormous increase of interlobular connective tissue growing around the bile-ducts and extending toward the junction of these with the liver-cells. I have been indebted to Dr. Rolleston for material from this case, also one of congenital obstruction, and in this, coupled with evident dilatation of the intralobular bile-capillaries, there was an exquisite development of fibrous tissue, which was confined to the immediate neighborhood of the bile-ducts. J. GEORGE ADAMI.]

In all such cases the organ is enlarged, smooth, and fibrous, and progressive jaundice is the leading feature.

2. BILIARY CIRRHOSIS PROPER.

Synonyms.—Hypertrophic biliary cirrhosis; Hanot's cirrhosis.

So long ago as 1857 Todd drew attention to the fact that two different forms of chronic hepatitis are to be recognized, and quoted cases of enlarged cirrhotic liver without ascites, but with jaundice. Thus, if the name of any person is to be associated with this form of disease, it would be that of Todd, and not of Hanot, who, while he was the first to give a full study of this form, was certainly not the first to clearly draw attention to its existence. In 1859 Charcot and Luys called attention to the fact that, in some cases of cirrhosis with enlarged liver, the new fibrous tissue penetrates into the lobules and becomes intralobular. In 1874 Hayem reported two cases of cirrhosis with enlargement, and in the same year Cornil pointed out the presence of great numbers of new bile-ducts in cases of cirrhosis of this nature; only in the following year, in 1875, did Hanot's well-known thesis appear upon the "Enlarged Cirrhotic Liver," in which he pointed out that in this form the enlargement is constant throughout, the surface smooth, and, microscopically, the cirrhosis is of the unilobular type and sometimes pericellular, with a plexus of small, new bile-canaliculi; while, clinically, he showed that this form was characterized by permanent jaundice without ascites, death being due to the jaundice. He described the condition as often due to a catarrhal condition of the smaller intrahepatic bile-ducts. The condition is a rare one, though each year two or three are reported in the journals. While in the majority of cases there is a definite history of hard drinking, the more recent observations of Hanot lead to the belief that the disease is of a possible infectious or microbic origin.

The liver in these cases may be enlarged symmetrically and may weigh as much as eight pounds.

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Observations on the form of hypertrophic cirrhosis with chronic jaundice described by Hanot. 1. The splenic enlargement persists unaltered during the whole course of the illness, although the variations in the size of the liver may be considerable and of frequent occurrence. 2. The splenic enlargement precedes the alterations in the liver, or, at least, it precedes the outward manifestations of the disease. In one of the cases, a man who died at about 30 of this form of cirrhosis, a large spleen had been noted during youth. 3. The disease may sometimes occur in different members of the same family. Children of patients may have a large spleen without any other sign of the affection. In one family the children are said to have a very pigmented skin, and this has been observed likewise in some collateral branches of the family. 4. The large spleen may be considered as the essential part of the disease. 5. Although ordinarily malaria has nothing to do with the affection, the cause is probably analogous to that of

malaria and dependent on drinking-water. 6. As Hanot and Riener admitted, the affection seems to be a specific one, or, at least, a peculiar infection of the spleen and liver, not a simple infection of the liver. E. Boix (Presse Méd., Mar. 16, '98; Brit. Med. Jour., May 14, '98).

Etiology.—In the first place, there is a marked distinction between this and ordinary portal cirrhosis, in that it affects young adults. By far the greater number of cases are in males between the ages of 20 and 35. Schochman, in the 26 cases which he collected, found that it affected 22 males and 4 females. In the majority of cases there is a definite history of hard drinking; but, as in other cases there has been no alcoholic history, we must conclude that alcohol is not the immediate cause. So, also, malaria is to be eliminated. On the other hand, there is increasing evidence at the present time—not, it is true, absolutely convincing—in favor of regarding this form as definitely of infectious origin. In favor of this view are the following facts:—

1. The febrile character of the disease. As Jaccoud was the first to point out, the fever may reach from 103° to 103 $^1/_2$° F.

2. The very frequent extension of the inflammation, development of perihepatitis, and surrounding adhesions.

3. The condition of the blood. As Hanot and Meunier have shown (Soc. de Biol. de Paris, Jan. 25, '95), the number of white corpuscles in the blood of five cases was increased from 13,000 to 20,000 per cubic millimetre. No such leucocytosis is observable in ordinary portal cirrhosis.

Hanot, in his recent communications, is strongly in favor of the infectious origin. On the other hand, no definite micro-organism has been discovered, save that the presence of the colon bacillus has been recognized in the ducts upon more than one occasion. The frequency with which this form may be present in the gall-bladder and larger bile-ducts and there set up mild chronic disturbances is, nowadays, being more and more recognized.

But were the bacillus coli the causative agent, we should expect to find the disease far more common and far more frequently associated with cholelithiasis.

Biliary cirrhosis is frequent among the children of certain classes in Calcutta and Bengal. It is insidious in its onset, usually prevails among infants under the age of 1 year, and seldom attacks children after the third year.

The attack generally commences about the seventh or eighth month, chiefly at the period of dentition or at the mother's next conception. The children of some parents are particularly liable to the disease. In one family fourteen children of the same parents died one after the other. It spares neither the rich nor the poor, though the well-fed children of the wealthy and the middle classes are much more liable to it than the ill-fed children of the poorer classes. Mohammedan and Eurasian children suffer less than Hindoos. Hardly any cases are seen among Europeans. The main causes of the disease attributed to unwholesome food and faulty digestion. Jogendro Nath Ghose (Lancet, Jan. 5, '95).

This fatal form of cirrhosis is peculiar to the Brahmin children. Brahmin women in childbed adopt a diet which may conduce to the disease in the newborn infant, in whom it has been seen. They restrict themselves to the use of a strong decoction of black pepper to allay thirst, abstaining from liquid of any other kind, and as food use balls made up of boiled rice, *ghee*, and coarse sugar. E. Mackenzie (Lancet, Feb. 2, '95).

Closely allied to this above variety of cirrhosis is the "pericellular cirrhosis" (*vide infra*): a form definitely associated with infection. Hence, on the whole, from all these considerations I am in-

clined to regard this provisionally as being a cirrhosis of infectious origin.

Pathology.—The liver is symmetrically enlarged and may weigh as much as eight pounds; it is, in general, smooth, herein being distinguished from portal cirrhosis; more frequently in that disease there are evidences of perihepatitis and of adhesions to the diaphragm and surrounding viscera. This perihepatitis at times gives a very hard surface to the organ. In the latter stages of the disease, where the condition has been of long continuance as Goluboff more recently has pointed out (Zeit. f. klin. Med., vol. xxiv, '94), there may be a certain amount of contraction of the enlarged organ, and the surface may take on a slightly-granular appearance. On section, the organ cuts very firmly, and has an intensely-jaundiced, dark-green appearance; the gall-bladder is full of bile of good color, clearly indicating that there is no absolute obstruction to the flow of bile from the organ, while the extrahepatic bile-ducts are free from obstruction.

Microscopically, the appearance is characteristic. Frequently, though not always, there can be made out around the larger bile-ducts, which are very prominent, a more or less concentric overgrowth of new, fibrous tissue, and this fibrosis, instead of being sharply defined toward the lobules of the organ, invades them, passing between the cells; so that there is developed a pericellular condition. With this the fibrosis is very general, so that not only do we have large bands inclosing several lobules, but in addition each individual lobule tends to be surrounded, and, more than that, bands of the new tissue may actually cut off portions of lobules; there is thus developed a unilobular cirrhosis, as contrasted with the multilobular appearance in portal cirrhosis. Another very characteristic feature of the condition is the appearance of the new, fibrous tissue; this tends to be more transparent than, and not so dense as, that seen in the ordinary portal form, while it is permeated by great numbers of bile-canaliculi. As to the nature of these bile-ducts, opinion is divided, some holding them to be of the nature of new formation from the pre-existing bile-ducts, others holding them to represent a late stage in the atrophy of the liver-cells. My own observations lead me strongly to support the latter view, for, in several sections in which they have been abundant, I have clearly made out the transition from the liver-cell to bile-duct.

From comparative anatomical grounds this would seem to be the most reasonable explanation of their development. That is to say, that following the successive stages of the evolution of the liver we find that in its earliest form the organ consists of a mass of independent finger-like follicles. Later these become joined together into a more solid mass, and with this a distinction can be made out between the lower duct-like portions and the secretory terminations of the follicles. Later again the cells become arranged more in reference to the blood-vascular system than to their primary connection as members of separate follicles. But still in the human liver the bile-capillaries must be regarded as the representatives of the lumina of separate hepatic follicles, and in peripheral atrophy of the lobules, where that atrophy is not extreme, the appearance which these sections present to me leads me to conclude that the secreting cells of the liver undergo what I have elsewhere termed "reversionary degeneration" (*vide* article on "Inflammation" in volume i of Allbutt's "System of Medi-

cine"). The nuclei proliferate, and in place of obscurely arranged masses of typical liver-cells, we obtain small rows of cells resembling those of the bile-ducts, with which they become continuous.

> [In this connection it is interesting to note the presence of these new bile-canaliculi in cases of parenchymatous hypertrophy occurring in connection with portal cirrhosis and in the transitional cases between such hypertrophy and actual adenomatous development. J. GEORGE ADAMI.]

The general appearance of the larger bile-ducts, their abundant and proliferating epithelium, supports the view of Goluboff and some of the recent French observers, that we are here essentially dealing with a chronic diffuse catarrhal angiocholitis with chronic diffuse periangiocholitis. At the same time it may be that the liver-cells are also directly affected, and that there is here a replacement-fibrosis in addition to the inflammatory, for the character of the new connective tissue, especially at the margins of and invading the lobules, is not of a productive inflammatory type.

With regard to the other organs, the spleen is, in general, enlarged, and sometimes there is great enlargement. The lymph-glands are not found markedly enlarged; the kidneys and other organs of the body are bile-stained, but beyond that present nothing characteristic.

Symptoms.—Pain is felt in the region of the liver of a dull character, with some tenderness. While the general health appears to be fairly good and the appetite to be excellent, there is a slight fever and very characteristic is the development of a series of more acute attacks of abdominal pain resembling mild hepatic colic, associated with each of which the jaundice becomes more marked. Gradually the abdomen becomes enlarged, the enlargement being due to the increased size of the liver, which, on palpation, presents a perfectly-smooth surface. The process is, in general, of slow development; only after months may the abdomen become markedly enlarged, and the enlargement may slowly continue for as many as eight years; but the jaundice is progressive and becomes so intense that the skin takes on a dark-green color. The jaundice is not obstructive, as shown by the fact that the stools continue to be stained. The urine, according to Hanot, shows slight diminution of the urea, is high colored, and contains abundant pigment. Throughout the disease there is absence of marked ascites, though in some cases there may be evidences of intestinal hæmorrhage. Sometimes there is a little fluid in the abdomen, and where this is the case it would seem to be associated with the development of perihepatitis and perisplenitis.

As the disease progresses, there is loss of strength, and with the progressive emaciation petechiæ may show themselves. Finally coma supervenes, and death occurs directly from the hepatic disturbance.

Thus, clinically the distinctions between this form of cirrhosis and ordinary portal cirrhosis are:—

1. The life-period at which the disease develops.
2. The enlargement of the liver and its smooth, or but slightly-roughened, surface (from perihepatitis).
3. The persistent jaundice.
4. The characteristic exacerbations of hepatic pain and of jaundice.
5. The absence of any marked ascites and of portal obstruction, save at the very end.
6. The preservation of an excellent appetite.
7. The long continuance of the condi-

tion after the recognition of the first signs of hepatic disturbance, and, associated with this, the slow emaciation and the retention of bodily strength.

It is all the more necessary to keep these distinctions in view, inasmuch as there is the painful confusion between this true biliary cirrhosis and those cases of portal cirrhosis in which there is the enlarged liver, either of the fatty type or again of the mixed, brought about by the indiscriminate employment of the term "hypertrophic." Nothing has more conduced to confusion with regard to cirrhosis than the employment of this term, and of the relative term "atrophic."

[Strictly speaking, the term *hypertrophy* of the liver should be employed to indicate an overgrowth of the specific liver-tissue,—*i.e.*, of the parenchyma,—but ought never to be employed to indicate the overgrowth of the connective tissue of the organ, or the mere fact that the organ is enlarged. In short, he who wishes to make himself clearly understood will do well never to use the term in connection with the liver. Similarly if the term *atrophic* be banished the unity of the various forms of portal cirrhosis will be better grasped. J. George Adami.]

Seven cases of biliary cirrhosis in children, presenting all the symptoms observed in the adult, but with the addition, in many cases, of hypertrophy of the spleen. The latter, in association with biliary cirrhosis, is peculiar to cases commencing in childhood. In some instances the ends of the femur and tibia were also enlarged. Gilbert and Fournier (Revue Mensuelle des Mal. de l'Enfance, July, '95).

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Case of Hanot's hypertrophic cirrhosis with chronic jaundice in which a very peculiar attitude of the body developed. The right shoulder was lower than the left, the right upper limb was also depressed, and the tip of the right middle finger was 4 centimetres below the corresponding point on the left side. The right side of the body, as a whole, was lower than the left, the right half of the pelvis and the right hip being depressed. The right gluteal fold was 2 centimetres below that on the left. There was no spinal curvature, and no anatomical lesion to account for it, and it appeared to be purely functional. Sicard and Remlinger (Revue de Méd., Sept., '97).

Diagnostic points insisted on in cases of hypertrophic cirrhosis with icterus: (1) enlargement of the liver; (2) hepatoptosis, or downward displacement of the liver; (3) icterus; (4) discoloration of the fæces. In similar cases, but in which the fæces retain their normal color, Hanot's disease is characterized by persistent jaundice, enlarged liver (gradually increasing and slightly tender on pressure), great enlargement of the spleen, no clay color of the stools, and no ascites. Léopold Lévi (Gaz. d. Hôp., Feb. 26, '98).

Prognosis.—To the best of our knowledge this disease is incurable, although it may be long years before death supervenes. A few cases have been recorded in which death has been of an acute course, occurring within a month. In one case recorded by d'Espine, in an infant, death occurred on the twenty-fifth day.

[I have, unfortunately, mislaid my notes upon this case. My memory of it is that this case is to be explained as a case of congenital obstruction of the bile-ducts, and as being more of the nature of the obstructive cirrhosis already referred to. J. George Adami.]

Treatment.—What has been stated concerning the treatment of hepatic cirrhosis would appear to apply, in a large measure, to the treatment of this form. Special care must be taken that the diet is bland and unirritating, because in severe cases errors in diet have appeared to induce the exacerbation above mentioned.

Stress laid on the importance and efficacy, at the outset, of calomel, to-

gether with milk diet. In the biliary form with intense jaundice, injections of salicylate of sodium, 15 to 30 grains to 1 pint of water, to be repeated daily. In addition, massage of the liver, cholagogues, appropriate diet, hot baths (with massage in the bath), and a course at an alkaline spring. Liebreich (Practitioner, Apr., '94).

Pericellular Cirrhosis.

As already stated, the condition of pericellular cirrhosis exists to some extent in biliary cirrhosis, and in the so-called mixed type of portal cirrhosis a certain amount of pericellular or monolobular deposit of connective tissue is to be recognized. But there exist cases in which the pericellular change is microscopically the most-marked alteration in the organ, and, inasmuch as these cases are, in general, unaccompanied by either jaundice or ascites, it becomes necessary to treat them as a separate class.

We rarely, in the adult, meet with a generalized form of the disease. The most frequent examples are to be met with in the infant in connection with congenital syphilis. Not infrequently it is to be found well-marked in children born prematurely, whether alive or dead, close upon term. It may, however, be very evident during the first months of extra-uterine life, and where this is the case it often indicates a syphilitic intoxication so severe as to lead to death before the end of six months; rarely do the children survive if the hepatic enlargement is very extensive. Occasionally, however, there may be this diffuse pericellular cirrhosis in the adult, possibly, according to some writers, among whom may be mentioned Tzeytline (Thèse de Paris, '96), of the nature of a delayed hereditary syphilis, in which case it is associated with the presence of gummata; in other cases too, more rarely, it is a manifestation of acquired tertiary syphilis. I have seen one case of this in which in addition to the presence of numerous well-marked gummata, there was this general pericellular development of delicate connective tissue with signs of progressive atrophy of the liver-cells. In this case, however, while the process was diffuse, it was most advanced in the neighborhood of the gummata, and there were areas in the liver showing relatively little fibroid change. Very rarely in tuberculosis there may be a similar pericellular change, though not so extensive as in syphilis.

In cattle, as first pointed out by Wyatt Johnston (Transactions of the American Veterinary Association, '93, and Appendix to Report of the Minister of Agriculture for the Dominion of Canada, '93), there exists in a strictly-limited region of Nova Scotia, around Pictou, a disease among cattle characterized by very extensive cirrhosis. The disease appears to be chronic, and death occurs after a brief period of acute delirium or from a progressive paresis passing on to complete paralysis with stupor. The disease most often is first recognized by the acrid taste and odor of the milk, which rapidly diminishes in amount, and with this, or earlier, the coat becomes "staring," the eyes prominent and very bright, and there is considerable looseness of the bowels. There is no jaundice and but a slight accumulation of fluid in the abdominal cavity toward the later stages. Upon killing the animal the main pathological changes are, in general, a moderate enlargement of the liver with some obtuseness of the angles; the surface is perfectly smooth. Microscopically there is marked evidence of parenchymatous and fatty degeneration of the cells, great diminution in their number, and replace-

ment by a delicate and very transparent connective tissue, which in more advanced cases is to be found more dense and more concentrated around the intrahepatic bile-ducts. There is no jaundice; indeed, in the twenty or so autopsies which were performed in this disease the gall-bladder was, in general, very full of bile or light color, the fæces were well stained, and, if anything, there appeared to be an excessive excretion from the organ.

Other well-marked features are the presence of a clear, limpid fluid in the abdomen (though this ascites is never excessive), a moderate enlargement of the abdominal lymphatic glands and of the glands at the hilus of the liver, and a peculiar gelatinous œdema of the coats of the fourth stomach and small intestines and of the mesenteries. In the fourth stomach, also, there are numerous follicular ulcers, generally found in a cicatrized condition. Studying this disease I constantly came across a minute bacillus presenting polar-staining, cultures of which were fatal to rabbits, guinea-pigs, and mice at periods varying, in rabbits, from a fortnight to a month, though in these cases the liver showed parenchymatous degeneration and almost singularly-slight early cirrhosis.

In some isolated regions in Germany and Switzerland the horses are said to suffer from a similar enzoötic cirrhosis.

Anatomical Changes.—Leaving aside these cases of pericellular cirrhosis of the lower animals, and referring more especially to the liver of congenital syphilis in the infant, the organ here is found very greatly enlarged, so that in some cases its edge may reach to the iliac crest; the surface is smooth and of a deep-red color, though I have come across cases in which there was a coarsely-mottled appearance of relatively-large areas of bright-yellow color standing out against the red. Upon section the organ is fairly firm, and, microscopically, the main feature is this infiltration, between the hepatic cells, of delicate connective tissue with, however, a fair infiltration of small, round cells, the hepatic cells showing evidences of marked atrophy. The portal sheaths are also greatly enlarged, and present considerable infiltration with small, round cells. There are, in general, evidences of the existence of miliary gummata, as minute small collections of round cells not very sharply defined are scattered irregularly through the organ; only in rare cases has the presence of occasional caseous gummata been noted.

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Syphilitic livers in infants. The most common change in such cases was the one in which there are irregularly-distributed foci of degenerated liver-cells, with small-celled infiltrations. They eventually lead to the distorted syphilitic liver. In one case, however, the liver was almost normal in macroscopical appearance, but microscopically showed a wide-spread and intense, round-celled infiltration in the portal capillaries. This form probably passes into a genuine hypertrophic cirrhosis in later life. Marchand (Cen. f. Allg. Path., No. 7, '96).

According to Hochsinger, four distinct main anatomical changes can be made out: 1. Diffuse small-celled infiltration. 2. Connective-tissue hyperplasia. 3. Miliary gummata. 4. Very rarely true nodular gummata.

Taking all these cases together, it is evident that this condition is distinctly of infectious origin, due, perhaps, not so much to the direct proliferation of the bacteria, for where that is the case, as in tuberculosis and syphilis, there is accumulation of small, round cells at the various foci of proliferation, but due to

a toxic effect of the bacteria upon the liver-cells, the development of the fibrous tissue being secondary to the atrophy of the parenchyma.

Experimentally, according to Aufrecht, a somewhat similar interstitial or pericellular cirrhosis is producible by the action of small doses of phosphorus frequently repeated. Such minute doses do not, like larger ones, lead to complete necrosis of the liver-cells, but the protoplasm becomes paler, the nuclei more evident and closer together, and the cirrhosis is diffuse and interstitial, exclusively due to the diseased hepatic cells more especially at the periphery of the acini. As is to be expected, poisons introduced into the system from without act like those developed within the organism (using this term in its broadest sense); so that some act primarily upon the intestinal walls and only secondarily upon the liver; others act directly upon the hepatic parenchyma, while all vary in their action according to their concentration.

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Diffuse "interstitial hepatitis," leading to cirrhosis, is never the result of an interstitial inflammation; it depends entirely on an inflammatory process, affecting the glandular cells of the peripheral parts of the acini. Human cirrhosis corresponds exactly with experimental cirrhosis as produced by phosphorus. Aufrecht (Deut. Arch. f. klin. Med., vol. lviii, p. 302, '97).

Symptoms (Syphilitic Pericellular Cirrhosis).—There seem no recognizable symptoms of this condition beyond the extreme enlargement of the liver, which is tender, and the co-existence of other evidences of the disease. There is, as above said, no ascites and no jaundice.

As above stated, this variety of cirrhosis frequently leads to intra-uterine death and to premature birth, and, where the child survives birth, death in general occurs before the sixth month. Where the enlargement of the liver is extensive, there appears to be little chance of recovery, though mercurial treatment has resulted in some recoveries.

Hochsinger (Zur Kenntniss des Angeborenen Lebersyphilis der Säuglinge," Vienna, '96) states that of 148 infants with congenital syphilis, 46 showed clinical enlargement of the liver. The large number of 30 of these are stated to have recovered. Five cases came to autopsy, and in 1 the enlargement was due to tuberculosis. In none of his cases was there icterus or jaundice; in these enlarged livers there was some extent of fat-infiltration. He is strongly in favor of immediate mercurial treatment.

Arterial Cirrhosis.

Contrary to what I believe is the generally-received opinion, I find that in cases of general arteriosclerosis branches of the hepatic arteries resemble other arteries throughout the body in showing a distinct periarteritis.

[Recently Hasenfeld (D. Arch. f. klin. Med., '97) has noted similarly a slight chronic endarteritis in the hepatic arteries in arteriosclerosis. J. George Adami.]

This periarteritis is rarely extreme and clinically is incapable of recognition, though Eichhorst is inclined to recognize a senile variety of cirrhosis due thereto, and analogous to the arteriosclerotic nephritis resulting from arteritis and periarteritis in the renal vessels. This arterial change is only of interest in that a large proportion of subjects with alcoholic cirrhosis present also a condition of general arteriosclerosis, and thus associated with alcoholic cirrhosis there may be independently a certain amount of fibroid development

in the portal sheaths due to the arterial disturbance.

Certain writers have suggested that the toxic substance leading to the development of what I have termed "portal cirrhosis" are brought to the organ by the arterial branches; if this be so, the anatomical evidence of the transmission is singularly small.

Centrilobular Cirrhosis.

In cases of well-marked obstructive disease, either of the heart or of the lungs, the liver is the seat of great, passive congestion, with atrophy of the central cells of the lobule. There is no sign of fibroid development in these regions; all that is to be seen is the great dilatation of the central capillaries of the lobule, with atrophy of the cells. In cases of a more chronic type with less severe obstructive disease we occasionally meet with a well-marked development of fibrous tissue immediately round the central vein of the lobule. It is debatable whether this is of the nature of a replacement-fibrosis in consequence of the atrophy of the central liver-cells or whether it may be termed "non-functional" or "non-inflammatory," due to the increased pressure in the hepatic veins and the altered character of the blood-flow. This form, again, while it may be predicated in cases of long-continued slight mitral or other obstructive disease, is associated with no clinical symptoms.

Hanot and Gilbert have, however, described a venous "hypertrophic" liver with enlargement, the organ remaining enlarged. If this form truly exists, it will be clinically impossible to differentiate it from the enlargement due to accompanying passive congestion.

Secondary Cirrhosis.

Synonyms.—Cirrhosis following upon perihepatitis; Glissonian cirrhosis; *zuckerguss leber.*

While chronic perihepatitis may either be localized, and in patches over the surface of the liver, or generalized, it is with the generalized form that we have to deal in an article on "cirrhosis." Such generalized perihepatitis is a very characteristic condition pathologically, though clinically it may be present in an advanced form without any signs of its presence, and, on the other hand, may ape and be almost, if not quite, indistinguishable from the atrophic and contracted form of portal cirrhosis.

Etiology. — Such thickening of the capsule of the liver may be one of the results of a general peritonitis; indeed, it must be regarded as one evidence of such a condition.

Of 22 cases of universal perihepatitis in the post-mortem records at Guy's Hospital collected by Hale White (Allbutt's "System of Medicine," volume v, p. 118), in only 2 was it stated there was no peritonitis; in 17 it was distinctly stated to be present, and in the remaining 3 no mention was made of the peritoneum. Hale White suggests that in his cases the peritonitis was always fibroid and so never owed to tubercular growth; this, however, is contrary to the observations of other writers, and I myself have seen a most-marked condition of universal perihepatitis accompanying and evidently due to a chronic peritoneal tuberculosis, though it is true the thickened capsule in such case does not show a characteristically tubercular appearance throughout, but is fibroid in its deeper layers and homogeneous. But a study of chronic tuberculous pleurisy shows that the process may assume this homogeneous fibroid character. In fact it may be said that this form of universal fibrous perihepatitis is distinct from lo-

calized chronic perihepatitis in that it is an extension of inflammatory disturbance from without the liver, and not from within, as may often happen in the latter condition, and that anything capable of setting up a chronic productive inflammation in the abdominal cavity is also capable of producing this form of disease.

Pathological Anatomy. — In consequence of the deposit of this thickened, new, fibrous tissue over the surface of the organ and its contraction, the liver becomes more globular in appearance than normal, though it is to be noticed that, in general, the thickening is more marked on the upper and anterior surface than on the under surface. Frequently, as Fagge, I believe, was the first to point out, the anterior edge is folded over on to the dorsum in a manner that is difficult to explain. Frequently, also, the omentum, shortened and thickened by the universal peritonitis, is adherent to the lower edge of the organ; and this thickened mass may be mistaken for the edge of the liver. Frequently, again, the productive inflammation on the surface leads to adhesions, more especially anteriorly and to the diaphragm.

As Hale White points out, often little pits are to be seen on the surface of the thickened capsule; when seen they are very striking. I have only seen them upon the upper diaphragmatic aspect of the organ in regions where there have been no adhesions, and from their position and character I am inclined to believe that they are brought about by little eddies opposite to the lymph-stigmata in the under surface of the diaphragm. A marked feature is the ease with which the thickened capsule can be peeled off, leaving, in general, a smooth surface.

Authorities differ as to the connection between this perihepatitis and cirrhotic change in the organ itself. According to Murchison and Osler, it is frequent, but Fagge, Hale White, and Curschmann (Deut. med. Woch., p. 564, '84) speak of the condition as, in general, unaccompanied by any interstitial inflammation. And, in the not very frequent cases which I have come across, I also have found the liver soft and pulpy, rather than fibroid. Evidently both conditions may exist, and, speaking correctly, it is only the former condition where there is this extension of the inflammatory process inward along the lymphatics, leading to the development of fibrous bands within the organ; or, again, where there is an extension upward of the process into the organ along the sheaths of the portal vessels at the hilus, which ought properly to be spoken of as cirrhosis.

With regard to other organs. The spleen, in general, shows a like capsular thickening, more especially of its diaphragmatic surface, and, as Hale White, who has made the fullest study of the condition, points out, there is a very frequent complication of interstitial nephritis.

Symptoms. — Frequently, as above stated, there are no symptoms recognizable; but, in a typical condition of the disease, we find the liver smaller than normal, with thickened uniformly blunt edge, and, associated with this, marked ascites.

Hale White points out that the condition is of long duration, and that the ascitic fluid can be repeatedly tapped. There is an absence of jaundice, while evidences of chronic peritonitis and, again, of interstitial nephritis, are well marked.

At times a friction-sound can be made

out over the liver, though this is rare; more frequently the organ, by adhesions to the abdominal wall, becomes fixed and it does not move downward on inspiration.

In London apparently this condition is fairly frequent, for Fagge makes the statement that, at Guy's Hospital, for every five cases that die showing portal cirrhosis with ascites there is one in which the ascites is associated with perihepatitis.

Treatment.—Where there is such extensive perihepatitis, treatment cannot be curative, but can only be palliative, and, of palliative measures, tapping is the most important.

Sporadic Cirrhosis.

I would employ the term "sporadic cirrhosis" to indicate those cases in which there is a fairly-extensive development of fibrous tissue throughout the liver in scattered patches related definitely in origin to no one special portion of the lobule or of its surrounding sheath. Where the development is slight, we can scarcely speak of cirrhosis; but in some cases the connective-tissue development may be very extensive, and here we must speak of cirrhosis.

Two main series of cases are to be included under this heading:—

1. The fibrous-tissue development in consequence of the presence of multiple infectious granulomata: a condition seen in tuberculosis and syphilis.

2. The condition to which our attention has been more especially directed by Welch, Flexner, Barker, and the Johns Hopkins School, in which, apparently from the action of toxins rather than from bacteria, multiple focal necroses are developed in the liver. These focal necroses pass through the successive stages of slow death, infiltration with leucocytes, and organization and formation of fibrous tissue, leading eventually to the development of fibrous tissue; so that scattered through the organ are little, irregular nodules of fibrosis.

Yet a third form may be recognized, for the recognition of which we are again indebted to Welch, namely: that form of cirrhosis due to the conveyance into the liver by lymph or blood of discrete particles of foreign matter, as, for example, of carbon or of stone. Around about such little collections of foreign particles there may be developed here, as in the lung, a noticeable amount of fibrous tissue; but, in general, the condition is very slight.

I have come across it both in connection with anthracosis and again in connection with stone-mason's lung, or silicosis; but to the best of my belief Welch's well-known case of cirrhosis anthracotica is the only very extensive and truly cirrhotic case upon record.

1. Cirrhosis Due to Infectious Granulomata.—In general, tuberculosis affecting the liver leads to no recognizable symptoms, even though the liver be thickly studded throughout with fibroid tubercles; very rarely we have a caseous mass. Beyond, therefore, mentioning the existence of this form, it is unnecessary for me to say anything further concerning it.

With syphilis it is different. Here dense bands of new tissue may radiate in various directions around the fibroid and caseous gummata. Where these gummata are frequent, the obstructive effect of the bands and again the deformity of the organ may lead to signs and symptoms which closely simulate either the atrophic or parenchymatous hypertrophic form of portal cirrhosis. But even in the most extensive cases the development of this fibrous tissue is so sporadic, and the condition of the other parts of

the organ is so relatively healthy, that, strictly speaking, these cases ought not to be spoken of as cirrhotic.

For its symptomatology, this gummatous form depends upon the number and the position of the gummatous growths in the organ and the amount of fibrosis developed in the immediate neighborhood. As these gummata have no points of election and may occur on the upper surface and away from the vessels at the hilus as frequently as they occur in its neighborhood, it follows that we may have, on the one hand, an advanced gummatous condition of the organ unaccompanied by jaundice or by ascites or by any recognizable disturbance; while, on the other hand, there may be but a few gummata, and yet these, being situated in such a position as to obstruct either the main branches of the portal vein or some of the main bile-ducts within the organ, may induce either ascites or icterus, or both. In advanced cirrhosis, where there are numerous gummata, it may be possible to palpate the lower portion of the organ, and to recognize the scarred and coarsely-nodular condition of the surface; or, again, as in advanced portal cirrhosis, the organ may be, by the contraction of the fibrous tissue, so retracted behind the ribs as to be incapable of being felt. Where this is the case, it is impossible to make a diagnosis between tertiary syphilis and the liver of alcoholic cirrhosis, unless the evidence of syphilitic infection of other organs is present. Where there is doubt as to the nature of the condition, progressive improvement manifested under the potassium-iodide treatment will clear up the diagnosis. Osler distinguishes a group of cases in which the patient is anæmic, and passes large quantites of pale urine containing albumin and tube-casts; the liver is enlarged and, perhaps, irregular; and the spleen also is enlarged; while ascites may supervene. In such a case the presence of gummata is associated with amyloid degeneration of the organ, of the intestinal mucosa, and of the spleen. He further points out what is, perhaps, not very uncommon: that the large projecting masses of liver-tissue produced by the contraction of gummata affecting the left lobe are apt to be mistaken for new growths occurring in connection with the organ. Here, again, potassium iodide affords valuable aid in diagnosis.

In brief, the history of syphilitic infection, and the effects of treatment by potassium iodide, are the main diagnostic aids in differentiating syphilitic or other forms of cirrhosis.

2. The Cirrhosis of Focal Necroses.—As yet we know and pathologically have been able to recognize singularly few cases of cirrhosis originating from focal necroses. Such focal necroses occur in a large number of infectious diseases. Not only have they been recognized by Welch and Flexner in diphtheria, by Reed and subsequent observers in typhoid fever, and by numerous observers in tuberculosis, but by Guarnieri, Thayer and Hewetson, Barker, and others in malaria; and Flexner, in his experimental work upon toxalbumins, has been able to show that several vegetable poisons of the nature of toxalbumins will produce them and follow the development of cirrhosis following upon these focal necroses.

[Hanot (Comptes-rendus de la Soc. de Biol., p. 469, '93) describes as *taches blanches du foie infectieux* certain appearances which, he points out, characterize the liver in all forms of infectious disease; small irregular areas of pale color, appearing more especially on the convex surface, in which upon micro-

scopical examination a condition of dilated capillaries with abundant intravascular and extravascular leucocytes are to be made out. The liver-cells in the regions show degenerative changes. The condition is allied to the focal necroses. J. GEORGE ADAMI.]

As to the exact causation of the necroses, some doubt must, I think, still be expressed. While it is possible that, as many observers believe, they are directly due to the action of toxins, it is difficult to comprehend why such toxins should pick out only specially-isolated portions of the organ. One would expect to find that in addition to the action of the toxins there is some disturbance of the circulation, some thrombosis, or other change in the smaller veins or capillaries of the part, whereby the cells, being imperfectly nourished, undergo destruction.

[A full and interesting discussion of the matter is to be found upon page 386 of Flexner's remarkable monograph ("The Pathology of Toxalbumin Intoxication," Johns Hopkins Hospital Reports, vol. v, '97). Barker, in his studies upon malaria, and Schmorl, in puerperal eclampsia, have drawn attention to the existence of intracapillary thrombi in connection with these areas of necrosis. Flexner in his ricin experiments was forced to conclude that there is no causal relationship between the thrombi and the necroses, and that the localized cell-death is due to the intensity of action of the toxic bodies upon the tissue-elements and not upon the circulating blood or its channels. J. GEORGE ADAMI.]

J. GEORGE ADAMI,
Montreal.

CLEFT PALATE. See PALATE.

CLITORITIS. — Latin, from Greek, *κλειτορίζειν*, to titillate; and *itis*, inflammation.

Definition.—The question as to the frequency of this condition is one which involves great difference of opinion, and depends not a little upon the definition which one gives to it. If it is considered as an inflammation which involves the structures, as a whole, of which the organ is composed, it is, indeed, of rare occurrence; but if we include that adventitious form of inflammation, often of slight intensity, indicated by fibrous structures which are attached to and bind down its terminal portion, it is of great frequency. If all female children were carefully examined to determine its presence or absence it would doubtless be recognized much more frequently than it is. It would probably be found as often as the analogous condition which affects the penis of male children.

[The elucidation of diseases of the clitoris is a part of the work of modern gynæcology; there are still writers of works upon gynæcology who ignore the subject altogether. Attention was first directed to the subject, at least in a forcible manner, by the brilliant, but unfortunate, I. Baker Brown ("On the Curability of Certain Forms of Insanity," etc., pp. vii-85, 8°. London: R. Hardwieke, 1866), his zeal in this particular bringing upon his head the persecution of his London colleagues, which drove him out of the profession and brought him to a premature end. Brown studied particularly the relation, or the supposed relation, between the clitoris and certain diseases of the nervous system, and advocated the exsection of the former as a cure for such diseases. A. F. CURRIER.]

Symptoms.—The venereal variety of clitoritis may be associated with either of the forms of venereal infection; that is, with chancre, chancroid, or gonorrhœa. True chancre of the clitoris is of rare occurrence. In a dispensary experience of many years among women with every shade of venereal disease I do not recall a single instance.

Dr. R. W. Taylor has informed me that he has seen it several times, and that

it was characterized by great pain, swelling, and induration, and reported a typical case in a woman, 21 years of age, who contracted syphilis from her husband. The clitoris and prepuce were indurated, enlarged, and very painful, and there was an ulcer at the tip of the glans. Local treatment with solution of caustic potash and lead-and-opium lotion produced relief. Other cases have been reported by Mauriac.

Chancroid of the clitoris I have seen several times, though Taylor thinks it is of rare occurrence. Its phenomena are those of chancroid on other portions of the female genitalia, viz.: local sore without great attendant hyperæmia in the structures of the clitoris, and usually enlargement of the neighboring inguinal glands.

Gonorrhœa involving the clitoris is not of infrequent occurrence. The phenomena are redness and swelling of the prepuce and to a greater or less degree of the organ itself; the accompanying pain may be considerable. Traumatic clitoritis is relatively of rare occurrence. It is the result of direct injury from violent coitus, from a blow, a thrust, or a fall, the clitoris sharing injury with the surrounding structures. The inflammation follows the course of inflammations of a traumatic character in similar vascular tissues, pain and swelling being the most prominent features.

> Primary inflammation of the clitoris is of extremely rare occurrence. Case which consulted the author about a week after menstruation for an itching of the upper portion of the vulva of ten days' duration. On examination the vulva appeared to be normal in color, and there was no discharge from the urethra or vagina. The uterus was in a healthy condition. On separating the lips the clitoris was found to be enlarged, reddened, and excoriated, its entire surface discharging an abundant purulent secretion. The hood was also inflamed and swelled; the vulva-vaginal glands were normal. The accompanying symptoms were a marked sensation of heat, exaggerated sensibility of the parts, and some impediment to locomotion, together with intense venereal desire, resulting in great fatigue and loss of sleep. The condition could not be referred to any exciting cause, but as the patient had had two previous attacks within six years, the author inclined to the belief that there was a rheumatic origin. Under soothing lotions and the application of cocaine ointment the inflammation rapidly subsided. Philippeau (Gaz. de Gynéc., Feb. 1, '91).

Etiology and Pathology.—It is somewhat surprising that inflammatory phenomena of a decided character are not more frequently connected with the clitoris when we remember its exquisite sensitiveness, its abundant blood-supply, and its constant exposure to irritation during the entire period of life in which the tissues of the genital organs are in an active functional condition. During childhood its conspicuous position invites the injuries to which childhood is unusually susceptible, and it is also in danger from uncleanliness, from parasites, and from masturbation. After the external genitals have acquired complete development and the mature condition which follows puberty has placed the organ in a less exposed situation there is still danger from traumatism, though not to a great degree; from uncleanliness, from masturbation, from violence in coitus, and from the poisonous influence of venereal disease. It would seem that the susceptibility to injury increased with the size of the organ, a large organ being an anomaly and requiring constant care and precaution. This fact emphasizes the necessity that the family physician be acquainted with the peculiarities of his patients in order to safeguard them from evils which may be avoided.

The clitoris may be the seat of cystic

disease from hæmorrhage or other cause (Peckham), of syphilitic new growth (Kelley), of carcinoma, and less frequently of sarcoma (Robb), of hypertrophy, in addition to various congenital deformities and defects. Its appearance in spurious hermaphrodism is a very good illustration both of hypertrophy and of congenital deformity. These statements are made incidentally, since a true inflammation may be associated with either of these conditions, a true clitoritis being then present.

Inflammatory disease of the clitoris may, therefore, be prenatal or postnatal in its origin, congenital or acquired. In the great majority of cases it is prenatal; that is, it originates during fœtal life. Why such a condition should arise so frequently during this period is not known; but the fact remains that many female children come into the world with the glans clitoridis surrounded by more or fewer bands of adhesion, binding it down, interfering with its circulation and development, and furnishing cause for more or less subsequent irritation and disturbance.

Of the postnatal, or acquired, form of the disease, while there are occasional instances in which it is caused by uncleanly habits, by parasites, and by the extension of dermatitis affecting the contiguous tissue, in the greater number of cases it will be due to venereal infection or to traumatism.

With reference to its etiology, therefore, the disease may be classified as (1) congenital, (2) venereal, and (3) traumatic.

Of the causes of the congenital variety we are ignorant, as has already been remarked.

The bands and strands of fibrous tissue of greater or less density and firmness, which are its visible consequence, attach its glans to its prepuce, or hood, which is formed by the coalescence of the nymphæ, and to the surface which lies immediately around it. The contraction of this tissue, according to its abundance and firmness, interferes with the development of the organ, produces irritation, and probably leads, in not a few instances, to the habit of masturbation. It is conceivable, as Baker Brown insisted, that certain forms of nervous disease might result in consequence of such conditions, but the number of cases in which such a relationship has been carefully observed must be quite small. In the great majority of cases it is believed that the resulting disturbance has been too slight to require attention and treatment from the gynæcologist.

Treatment.—There is little to be said concerning the treatment of clitoritis of whatever variety.

Rest in bed is essential; local cleanliness equally so. In the congenital variety the adhesions must be removed, and this can usually be done by retracting the prepuce with the thumb and forefinger of one hand while the forefinger of the other is rubbed over the glans with sufficient firmness to remove all obstructions. The bruised surface may then be dusted with iodoform, aristol, or nosophen, and this process repeated daily as long as the surface remains broken. For the venereal variety a 10- or 20-percent. solution of nitrate of silver should be applied daily upon absorbent cotton until pain and swelling have subsided and the ulcerated surface has healed. For the traumatic variety only soothing lotions will be required. Lead-and-opium wash, frequently applied upon absorbent cotton, will serve the purpose sufficiently well.

Andrew F. Currier,

New York.

CLUB-FOOT. See FOOT, MALFORMATIONS OF.

CLUB-HAND. See HAND, MALFORMATIONS OF.

COCA. See ERYTHROXYLON COCA.

COCAINE. See ERYTHROXYLON COCA.

COCAINOMANIA, OR COCAINE HABIT.

Definition.—Cocainomania is an irresistible craze, crave, or impulse to intoxication by cocaine, or any of its salts or combinations, at all risks. Unless a cure of the "habit," or, more accurately, the disease of cocainomania be effected, the cocaine *habitué* cannot refrain from resorting to the drug, if a supply can possibly be procured, whenever the craze, crave, or impulse seizes upon him.

Varieties.—The two leading types of the cocaine habit are (1) *periodical*; (2) *continuous*. In the former the *habitué* will, after an outbreak of cocaine intoxication, go on without cocaine in any form for a longer or shorter interval, till a condition of mental unrest, arising sometimes apparently from within, ushers in a period of more or less complete temporary abandonment to the drug. Sometimes the outburst is inaugurated by a recurrence of the acute pain, or the asthma, or other physical trouble, for the assuagement of which the poison was originally taken. In some highly-strung women the menses act as the exciting provocative, particularly when accompanied by acute dysmenorrhœa. In the latter variety, the continuous, the unfortunate victim keeps on steadily taking the drug daily in rapidly-increasing quantities till he or she is rendered incapable of exertion, sometimes of connected thought, by advancing paralysis or by insanity. In some instances the indulgence is *social*, in others *solitary*, the latter being the rule and the former the exception. Some variation is observable when cocaine addiction is associated with alcoholic or other narcotic indulgence. In this way the addiction may be double, triple, or fourfold: twofold, as alcohol or morphine with cocaine; threefold, as with alcohol and chloral; fourfold, as with alcohol, morphine, and chloral.

Symptoms.—On taking a fresh dose, in chronic cocainomania, there are, generally within ten minutes, exuberance of spirits, quickened pulse, general acceleration of the circulation, talkativeness, restlessness, hallucinations, with rapid and somewhat spasmodic breathing, intense joyous activity, and a remarkable overconfidence in one's capacities and strength. Even when actually weaker, during the cocaine-delirious intoxication, the taker feels infinitely stronger and more agile. Occasionally there is vertigo, with some confusion of the intellectual faculties. There is usually great cerebral excitement, with dilated pupils, throat dryness, and headache, the last named frequently not severe enough to be painful. There is a rise of temperature, with a loss of the sense of time, though memory is usually intact. Depression and prostration follow very often. When the dose has been relatively moderate,—*i.e.*, not larger than the cocaine-taker has been gradually accustomed to take,—the period of nervous hyperexcitation has passed away by from half an hour to two hours. When the dose taken has been relatively immoderate, the depression and nervous debility may remain for days or till the next dose.

In chronic cocaine poisoning, though some habitual cocainists do not appear

to show any symptoms of injured health or vigor, others appear wasted, with pale-yellowish skin, the extremities clammy, with cold perspiration. The eyes are glistening and sunken with dark, subocular rings, the pupils being dilated. Anorexia and impaired digestion are present, with palpitation, dyspnœa, tinnitus aurium, tremors, neurasthenia, and uncertainty of step. Hallucinations, especially of sight and hearing; mistrust; delusions of persecution; and general paralysis sometimes end the scene. Yet, in some cases, one sees occasional spells of brightness, brilliance, and mental activity.

[The effects of chronic cocaine intoxication are as follow: Physically there is the rapidly-developing marasmus so characteristic of chronic cocaine intoxication. Psychically we find feelings of apprehension; delusions, chiefly of persecution; and hallucinations, visual or sensory. Frightful forms appear everywhere, or small living things creep upon the skin. Insomnia, loss of appetite, and impotence complete the picture of cocainism. OBERSTEINER, Corr. Ed., Annual, '89.]

Three cases of chronic cocainism in which the predominant symptoms were those relating to general sensibility, consisting chiefly of hallucinations producing a sensation as if foreign bodies were under the skin. The first, a merchant aged 48, was continually scraping his tongue, imagining that it was filled with small, black worms, and picking the skin to find choleraic microbes. The second, a pharmacist, attempted to extract microbes from his skin with his nails and with a needle. The third, a physician, sought for crystals of cocaine under the skin. Hallucinations of cutaneous sensibility are first to develop; hallucinations of vision, hearing, taste, and smell occur later. Disturbances of ideation, as delirium, are consecutive to the hallucinations. The latter are less active than those produced by alcohol or absinthe. Epileptiform attacks occurred with two of the patients and cramps in the third. Toxic epilepsies, when there is no predisposition, disappear with the cause. Magnan and Saury (La Tribune Méd., Feb. 3, Mar. 28, '89).

Aphrodisiac effects of cocaine shown in the case of a woman, married and highly respectable, who became a victim of cocaine, and who, while under its influence, would invariably utter expressions and do things which she would not even have thought of when in her normal condition. These effects appear to be more pronounced in females than in males, and hence the inadvisability of the indiscriminate use of cocaine. M. K. Bowers (Med. Age, Dec. 26, '91).

Case of chronic cocainism, in which the patient suffered from hallucinations, under the influence of which, according to his statement, he twice committed assaults. Regarded as a case of cocaine epilepsy, on account of the suddenness of his attacks of *furor* and a certain amount of amnesia. He formed the habit by using it for a nasal trouble. Lewin (Deutsche medizinal-Zeit., Jan. 1, '91).

Literature of '96 and '97.

Magnan's sign—an hallucination of cutaneous sensibility, characterized by a sensation of foreign bodies under the skin, which are described as inert and spherical, varying in size from a grain to a nut, or as living organisms, worms, bugs, etc.—observed in two cases. Ribakoff (Gaz. degli Ospedali e delle Clin., Aug. 4, '96).

The first feeling a cocainist has is an indescribable excitement to do something great, to leave a mark. But this disappears as rapidly as it came. The second sensation—at first, at least, no hallucination—is that his hearing is enormously increased. Very soon every sound begins to be a remark about himself, mostly of an offensive kind, and he begins to carry on a solitary life, his only companion being his syringe. Every passer-by seems to talk about him. After a relatively short time, he begins the "hunting of the cocaine bug," and imagines that, in his skin, worms or similar things are moving along.

Personal opinion that there is a ques-

tion of disturbance in the frontal cortex, originating, perhaps, in skin dysæsthesiæ, and not a simple visual hallucination or retinal projection. Springthorpe (Quarterly Jour. of Inebriety, Jan., '97).

In *acute* cocaine poisoning there may, or may not, be the exhilaration stage, the poisoned sometimes falling rapidly into collapse and insensibility after exceedingly transient symptoms of paleness, faintness, fullness of head and giddiness, skin creepings, profuse perspiration, præcordial distress, rapid hard or weak pulse, loquacity, restlessness, agitation, and hysterical excitement. The pupils are dilated and dull, the perspiration, at first quickened, becomes spasmodic and labored, unconsciousness sets in, convulsive seizures appear after muscular cramps, sometimes with tetanic spasms, followed, it may be, by deepening cyanosis, violent delirium, enuresis, and paralysis of the sphincters. Withal there are often localized areas of anæsthesia. In non-fatal cases, though the acute symptoms may pass off in a couple of hours or so, feelings of languor, malaise, and local pains may linger for days.

Differential Diagnosis.—Though, in many cases, unless the presence of cocaine can be determined by finding the drug or by the brown stain over the seats of hypodermic injection, this particular "habit" or mania cannot be diagnosed from other forms of narcotic addiction, there are one or two prominent symptoms which point to cocaine as the special mania. Especially in the earlier stages, though to a larger extent in the more advanced, alcohol is excluded by the absence of symptoms pointing to organic functional bodily lesion. The cocainomaniac not only often shows no symptom of bodily or mental disturbance, but manifests simply a sense of satisfaction, and an appearance of increased capacity for intellectual and muscular work. In many cases the closest physical examination has failed to reveal anything abnormal. Indeed, at times the only symptom discernible has been an apparently improved condition. In some instances only the closest continuous scrutiny of a business partner or a wife has, after a time, disclosed even the slight falling off in the character of the work and of the judgment, the actual amount of work having been occasionally increased. One point of differentiation, even from etheromania (which is more speedy in the appearance, progress, and cessation of toxic symptoms than either alcohol, opium, morphine, chloral, or chloroform), is the greater quickness with which the characteristic phenomena of cocaine poisoning set in and pass away. Still another discriminating symptom is the extraordinary self-confidence and elation arising from cocaine. In etheromania the odor of the breath is characteristic, and the activity more effervescent and demonstrative. A point of distinction from alcoholomania is that, while this is mostly social and less often solitary, cocainomania is almost always solitary. Yet another difference from alcohol and morphine is that the prevailing delusions of cocainomania are delusions of persecution. These rarely occur with alcohol, except temporarily sometimes in delirium tremens or in chronic alcoholism, and still less often with morphinomania. They are frequently seen, however, with the chronic cocaine habit, and are at once more marked and more persistent with cocaine.

Alcoholism. — The subject of this disorder shows greater evidence of morbid change; the subjective and objective symptoms are more marked. There is distinct attraction for social pleasures,

whereas the narcomaniac prefers solitude.

MORPHINOMANIA. — Characteristic symptoms set in and disappear more quickly. Cocainomania is characterized by marked self-confidence and elation.

ETHEROMANIA. — The odor of the breath is characteristic and the activity more effervescent and demonstrative.

Etiology.—The chief predisposing influence is, undoubtedly, the neurotic diathesis. On the nervo-sanguine and passionate temperaments cocaine has a special excitant power. Once taken in any form for the assuaging of acute pain, on such temperaments this drug fastens as if with a grip of iron imbedded in velvet. In one case of a life-abstainer from alcohol, cocaine, taken once during a prostrating attack of agonizing pain, exercised so powerful a hold that only after a strenuous struggle of over a week's duration could the veteran nephalist overcome the imperious impulse to take a second dose. He felt that, if he yielded, his will would have been rendered powerless for the future against the tremendous fascination of the drug which has banished his pain as if by magic, and of the name and other properties of which he was utterly ignorant. In "neurotics" I have seen a few doses, taken medicinally, set up the "cocaine habit." In transmitted gout, with irritable and susceptible brain and nervous system, this special predisposition has been markedly present. It has also been noted in syphilis and scrofula with cerebral complication. Epileptic neuroses have been greatly in evidence.

EXCITING INFLUENCES. — Over and above the psychological excitation of the drug itself, the exciting causes seen by me have practically been confined to urgent clamor for relief from physical agony, such as occurs at times in asthma or neuralgia.

> Case of a diabetic female who suffered from severe pruritus vulvæ, which was relieved by an ointment containing cocaine. The effect was so agreeable that the patient continued to make the application from four to six times a day. After a few days she began to exhibit the symptoms of acute cocainism, consisting of insomnia, extreme mental excitement with hallucinations, the sensation of impending death, rapid and irregular pulse, and sighing respiration. The symptoms subsided after the drug was discontinued. San Martin (Revista de Med. y Cir. Prâct., June 22, '91).
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> Two cases of young women having serious toxic symptoms, insomnia, visual and auditory disturbances, anorexia, gastralgic pains, and nervous manifestations. The origin of the intoxication was a snuff-powder containing cocaine, which has been prescribed for a form of rhinitis. Emphatic protest against the abuse of the drug in current prescriptions. Löwenberg (Bull. Méd., Mar. 17, '95).
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> [I have under my observation a lawyer who has been a slave to cocaine-inhalation, which, in my opinion, is the least noxious method of use. In this case the inhalation was prescribed for persistent asthma three years ago. The faculties have appeared to be heightened and more head-work has been done; but slight symptoms of brain-degradation and some unsteadiness of purpose, with will-paresis, have set in, the patient all the while believing himself improved. NORMAN KERR, Assoc. Ed., Annual, '96.]

I have not seen insomnia incite to cocainomania as it frequently does to morphinomania. Physical pain has been the initial starting-point. The use, for any purpose, of cocaine is an unmistakable influence inciting to the "cocaine habit" in constitutions predisposed to narcotic excitation. Other narcotic substances also both predispose and excite to the cocaine mania. Morphine, for example, long continued is apt to create

a crave or impulse too imperious to be satisfied with morphine narcotism alone.

> Case of mixed addiction, morphine and cocaine, the habit for the latter drug having been acquired by its use as a substitute for the former, with the usual disastrous results, namely: loss of appetite and sleep, vertigo, syncopal and epileptiform attacks, and, finally, hallucinations and delusions, ideas of suspicion, jealousy, and persecution; also hallucinations of animalcules on the skin, which are so characteristic of the action of cocaine. Cocaine is a toxic agent far more formidable than morphine on account of the rapidity and intensity with which the sensory, motor, and intellectual derangements develop under its use. Warning against employing it as a substitute for morphine with those addicted to the latter drug. Laury (La Sem. Méd., Aug. 10, '90).

In morphinomaniacs cocaine is sometimes resorted to simply with the object of heightening the pleasurable sensations of intoxication. In not a few instances cocaine addiction has been rapidly set up in the vain attempt to cure alcoholomania or morphinomania by substituting cocaine. This attempt at the cure of the original form of narcomania (a mania for narcotism by any narcotic) is sometimes openly attempted with the best intentions; but is more often unknowingly tried simply because cocaine has been a component of the so-called "cure," though not disclosed by the manufacturers. In this way even some abstainers from alcoholic liquors who pride themselves on their consistent temperance have insensibly become cocaine slaves, they having had no idea that they and theirs were partaking of a narcotic poison more fascinating and perilous than the object of their aversion: alcoholic intoxicants. A striking object-lesson of medical unwisdom was the appearance of a crop of cocainomaniacs in England shortly after the announcement, in a British medical annual, of the reputed cure of alcoholomania and morphinomania by means of cocaine, in another country.

Below sixteen years of age there would appear to be a lessened susceptibility as the years go down, children showing less cocainomaniac proclivities than adults, and not responding so readily to the narcotic properties of the drug in doses relatively corresponding to their years. Though the young are readily intoxicated by cocaine, they are not so prone to become subject to the mania for intoxication by cocaine.

As to sex, the majority of the cases have been male; but this has not arisen because of a lesser susceptibility that is found in man, but probably is owed to occupation exercising a stronger influence.

Occupation is a predominant factor, most of the victims having been medical men (I have seen a number of cases in members of the legal profession), literary men and women, and the cultured generally.

Climate exercises considerable influence, which may account for the greater prevalence of cocainomania in the United States of America and northern France, as compared to Great Britain. Racial characteristics and atmospheric conditions modify purely climatic environment, however; witness the practical absence of cocainomania among the great community of the Jews, and the rapid electrical disturbances, as well as the tremendous temperature alterations, of North America.

The cocaine inheritance has not had time to show itself, if it exist; but the "cocaine habit" as an outcome of transformed narcomaniac transmission I have seen in several families.

Pathology. — Acute Cocainism.— Though a large number of cases of acute cocaine poisoning have been recorded by Germain Sée, Mattison, Schede, and others, comparatively few have proved fatal. Probably the fatalities have run not much over 10 per cent. Even in exceedingly grave cases, when the sufferer appears almost moribund, the distress and collapse often suddenly and unexpectedly give way and the apparently dying patient makes a good recovery. Hence there has been little opportunity for post-mortem inspection. Clifford Allbutt says that the heart is found in diastole and the nervous centres are congested. According to Ehrlich, vacuolary degeneration is found in the hepatic cells, the latter being greatly enlarged and the nuclei atrophied. The convulsive respiratory paralysis is ascribed by Mosso to tetanus of the respiratory muscles, and the great rapidity of the circulation to paralysis of the vagus. The peripheral blood-vessels are contracted. Cocaine is stated to alter and injure the leucocytes; Maurel and Beaumont Small state that these become spherical and rigid, with increase of size. They seem also to have a tendency to locate next to the vessel-wall.

Death may supervene at an early stage from syncope, or at a later from asphyxia. Cocaine acts on the central nervous system, first exciting and afterward paralyzing this. Doubts have been expressed as to whether the anæsthesia produced by cocaine is due to the vasomotor disturbance or whether the drug directly paralyzed the nerve-terminations. Brown-Séquard believes the latter, holding that cocaine acts through the peripheral nerves on the nerve-centres, which reacts in inhibiting sensibility. I am inclined to think that the central nerve-centres are affected in both ways: by vasomotor paralysis and by peripheral excitation.

Chronic Cocainism, Including the Mania for Cocaine. A distinction ought to be made between the physical poisoning by the drug (cocainism), and the overpowering mania for the drug (cocainomania, or the "cocaine habit"). Of the pathology of the latter little can be said specifically. Usually scavenger or spider- cells are found in the brain; but as most cocaine *habitués* have previously been indulgers in alcohol, no reliance can as yet be placed on these appearances as pathognomonic of cocaine mania. Marasmus, with absence of fat, is usually the most prominent after-death appearance, and there has not been noted the darkish hue of the stomach's interior which has been seen in some cases of fatal opiomania. The post-mortem appearances include dark and fluid blood, with congestion of lungs and other organs, but these are not peculiar to cocaine poisoning. There have not been observed traces of cocaine tissue-degradation, and organic degradation which are so often met with in the stomach, liver, kidneys, and other vital organs of alcoholic cases, unless when chronic alcohol poisoning has preceded or accompanied the cocaine indulgence. When cocaine is contemporaneous with chronic morphine poisoning the wasting is even more marked. Though the minimum fatal dose in acute cocaine poisoning is not quite fixed, death has been recorded as the result of less than half a grain, and several deaths have occurred after 8 to 12 grains; yet the *habitué* can set up such a tolerance of the drug as to raise the daily consumption to some 30 or 40 grains. In some instances the daily average has been more than double this. In one case 80 grains a day were subcutaneously in-

jected, besides 60 grains of morphine. One death occurred in 20 minutes, 1 in 4 minutes, and a third in 40 seconds (Hamilton and Godwin).

Prognosis. — The prognosis of *acute* cocaine poisoning is, on the whole, favorable. Even though death almost always seems impending from the gravity of the symptoms, the great majority of cases recover if judiciously treated soon after the poisonous dose has been taken. Generally, after three-fourths of an hour have passed, the prognosis is even more favorable. This cannot so unreservedly be said of *chronic* cocaine poisoning (the cocaine habit, or cocainomania), of which the outlook is, under ordinary conditions, unfavorable. If, however, the patient surrender his liberty and place himself absolutely under control in a special home or in a hospital for a sufficiently long period, the prognosis may fairly be considered to be more favorable. The prognosis of cocainomania is not nearly so favorable as that of alcoholomania or even morphinomania. Cocaine exhausts the mental capacity more rapidly than either morphine or alcohol; it takes a greater hold on the brain and nervous system, reducing his intelligence and benumbing his faculties, setting up a moral palsy which seems to annihilate inhibition and to deprive the victim of all desire for deliverance. There are, however, exceptional cases which exhibit a strong wish to be cured, which are hopeful and have been delivered under treatment at home.

Treatment.—Acute Cocaine Poisoning.—If the poison has been swallowed the stomach syphon-tube should be at once applied and the contents of the organ evacuated. The patient should be placed in the horizontal position on his back. Tannic acid, iodine, or charcoal may be given as possible chemical antidotes. Stallard advises the stimulation of respiration and circulation by flicking the chest and face with hot and cold towels, as in opium poisoning; but I cannot say that I have seen benefit from this practice unless it has been done lightly and occasionally for a minute or two. Ammonia or ether inhaled, drunk by the mouth, or introduced into the rectum, or administered hypodermically, is useful, as also is the administration of caffeine or coffee. The addition of small quantities of alcohol, in the form of 5- to 10- drop doses of tincturæ cardamom. comp., spirit of chloroform, or tincturæ lavandulæ comp. (separate or combined), is sometimes serviceable when coffee cannot be easily taken. Chloroform may be inhaled to relieve the spasm. Strychnine, in minute doses ($^1/_{100}$ grain), with or without a couple of drops or so of tincture of digitalis, is also of value. Some authors report apparent benefit from intravenous injection of normal saline solution; but I think caution is requisite, owing to the risk of embolism in the lungs.

When the blood-pressure has been raised or there is alarming respiratory spasm, a drop-dose of nitroglycerin, at intervals of half an hour if required, sometimes acts excellently. Clifford Allbutt says that the inhalation of oxygen and artificial respiration against the asphyxia may be indicated. I have found sips of hot water; and, where this could not be taken by the mouth on account of insensibility or collapse, hot-water enemata, of 3 to 4 ounces, of substantial aid. External applications, as hot as can be borne, such as a bottle, or jar, or tin filled with hot water and covered with flannel to protect the skin, I make it a rule always to apply, especially in unconsciousness, and, indeed, almost from the first.

Chronic Cocaine Poisoning, or Cocainomania.—The treatment of the cocaine habit, or chronic cocaine intoxication, is very much more difficult. It is more essential to have complete control of the cocainomaniac and his actions than even in chronic alcohol or morphine mania. There is less to work upon in the brain- and nerve- centres of the chronic cocainist than in those of the chronic alcoholist or chronic morphinist. There is less mental and moral elasticity, less desire to be freed from the narcotic bondage, less consciousness of the bondage itself, a more helpless and hopeless wreck being difficult to find. Cocainomaniacs, however, are, in a few cases, cured without seclusion. In these hopeful cases there generally has been a greater stock of inhibition from the first. Again, the indulgence having been periodical and ordinarily provoked only by some recurrent neurotic pain or distress and leaving intervals of shorter or longer non-narcotic consumption between, inhibition has not been so paralyzed, and thus there has been more resisting power left. In the latter group of cases it is imperative to direct the treatment to the abolition or counteraction of the exciting influences.

In the mass of cases the main hope of cure rests in therapeutic seclusion. The patient must be treated as a diseased person. Diet, at first simple and readily assimilable, should be carefully attended to. Milk, with soda- or lime-water and effervescents if nausea and emesis are present; arrowroot or other farinaceous or malted food, and other peptonized preparations are excellent. Gradually, broths and plain soups, oysters, fish, poultry, and, lastly, mutton and red meat, with an ample supply of fruit and vegetables, may be given. But there are cases in which a non-fish-and-flesh dietary agrees better with the patient. Each case must be carefully observed to determine the most suitable dietetic instructions.

In the first week exercise and fresh air may usually be insisted on, with massage to improve the wasted condition of the muscles. Meals should be regular, and exercise graduated.

Alcoholic beverages are best avoided; and, though in a few cases tobacco in limited quantities may be allowed to aid in staying the morbid impulse or crave, most cocainomaniacs would be better without it in any form. Tobacco is apt, in many patients, to impair digestion and depress the heart's action, the healthy state of both vital processes being points of the highest importance in the treatment of this mania.

To combat the wearing insomnia of most cases I know nothing better than the hot, wet pack. Of all the medicinal hypnotics, I have found phenacetin the most useful, in doses of 5 grains, repeated, if necessary, every hour; no more than 3 doses (15 grains) to be taken in one night. Other physicians have found chloral and sulphonal serviceable.

An important practical point is the method of complete withdrawal of the cocaine, which complete withdrawal is essential to cure. In most cases I have not felt justified in immediate withdrawal, though I have done this where practicable. I spread the reduction period over from seven to nine days, beginning, whatever the quantity which had been taken daily or how long, with a reduction of one-half. Dr. Welch Branthwaite informs me that in five cases he at once, after only one dose, stopped the cocaine, without trouble. These were cases in which morphine had also been freely used. In the cases

in which I gradually reduced the dose of cocaine, morphine had not been habitually taken in large doses. Where morphine is also freely and regularly taken, it is easier to withhold the cocaine without delay.

> The best treatment of cocainism has been, in my hands, the administration of chloral in large doses. Opium was found to be feeble in its action, while some relief was obtained under the action of bromide of potassium by itself, or, better, in combination with the chloral. This latter alone is to be preferred. Good results also obtained from the use of alcohol, ether, and ammonia, especially when there is weakness of the pulse. Andrew Fullerton (Lancet, Sept. 19, '91).

All complications must be attacked, but, in the main, besides hygienic measures, nervine tonics are indicated in the endeavor to restore the lost energy and will-power which really constitute the disease. Of these tonics nux vomica and strychnine are the most effectual. Arsenic also is useful. I have found in this, as in other forms of narcomania, that an occasional replacement of the stronger nerve-tonics by milder ones is advantageous; I mean such as quinine, calumba, and gentian. Galvanism has, in appropriate cases, its value.

Though it is often asserted that 3 to 6 months suffice to effect a cure, my observation has been that 12 months constitute the shortest time in which such a result can be hoped for. There are, at the same time, a few exceptional cases in which a good result has been secured in a shorter period.

Medico-legal Relations.—As many cocainists will not apply for curative detention of their own accord, it ought to be the duty of the constitutional authorities to lay hold on these miserable and utterly helpless diseased persons, and insist on their reception and therapeutic seclusion for a given time, in a retreat, home, or hospital provided for the special treatment of such cases, with provision for persons with limited resources and for the very poorest. Such a provision would, in the long run, prove as economical as it would be invaluable to the welfare, physical and moral, of the whole community.

I am unaware of any trial for murder or for administering cocaine with intent to injure another person; but cocaine has been employed to commit suicide. It has been stated recently that forty cocainomaniacs appeared in the police-courts of Chicago within the period of a few months in 1897. The habit was said to have been induced, in some cases, by the use of popular preparations as cures for colds, etc. In the charters of various special institutions in the United States power is given to the managers to receive and compulsorily detain habitual inebriates who are addicted to excess in any narcotic or inebriant, including cocaine; but, in England, only excess in alcoholic liquors renders applicants eligible for admission into retreats under the voluntary provisions of the Inebriates' Acts.

NORMAN KERR,
London.

CODLIVER-OIL. See OLEUM MORRHUÆ.

COFFEE AND CAFFEINE. — The seeds or berries of *Caffea Arabica*, so extensively employed for the preparation of the beverage, are not officially recognized except as the main source of caffeine. A fluid extract of the green berry was formerly employed as a stimulant, however, and the infusion is now considerably used for the same purpose in the treatment of shock, poisoning, etc.

Before it is roasted coffee contains caffeine, caffeotannic acid, and—according to Palladine—an alkaloid: caffearine. During the roasting process, however, a volatile oil is developed, which, with the other substances, termed, collectively, "caffeone," give the coffee its agreeable aroma.

Administration and Dose.—The infusion affects its users in different ways, some tolerating large quantities, others feeling the influence of one-half cupful. There is, therefore, no special dose to be recommended.

The fluid extract of green coffee may be given in doses varying from 1 to 2 drachms.

Physiological Action. — Marshall and Hare have studied the action of the empyreumatic oil of coffee. The percentage of oil obtained from an average browned coffee is 11.6 per cent.; in consequence, an ordinary breakfastcup of coffee contains about 45 minims of the oil, provided all the oil in the coffee used is extracted. In their opinion, the oil possesses none of the powers of a toxic character heretofore supposed. The pure oil increases the pulse-rate by direct cardiac stimulation in small doses, and lowers pulse-rate in large doses by a direct depressant effect on this viscus. On the highly-developed spinal cord of the frog it causes increased reflex activity; but, on the mammal with a well-developed brain, drowsiness and sleep.

The virtues of coffee, in the wear and tear of active life, are entirely subjective, and depend upon a general excitation of the higher centres, and chiefly upon its powerful exhilarant action upon the mental processes. It must be said, however, that the assumed ability of coffee to replace food, or to increase the power for work without corresponding tissue-destruction, is deceptive. While a moderate consumer of coffee may be assisted by the stimulating action of the beverage, an intemperate consumer may be capable of performing prodigious feats of strength and endurance, but, nevertheless, at the direct expense of his tissues.

Prosorowsky studied the influence of coffee and some of its substitutes upon pathogenic micro-organisms, and concluded that coffee possessed incontestable antiseptic properties; in this respect it is superior to both its substitutes, rye and acorn coffee, the acorn being the more active of the two latter. The antiseptic action is due to the empyreumatic substances formed during roasting, and also partly to caffeotannic acids, the presence of which is alone capable of explaining the antiseptic action sometimes shown by infusions of raw ground coffee. A cup of coffee left in a room remains free from bacteria for over a week.

Poisoning by Coffee.—Rugh witnessed a case in which profound toxic effects from the drinking of large quantities of strong coffee were observed, a number of symptoms being those of beginning *mania a potu*. The patient's pulse was 96 and full, but weak; his respirations shallow and numbering 24 to the minute. The pupils were normal, the tongue slightly coated, the bowels regular; the skin moist, but not flushed; his expression was agitated with the fear of some impending danger. His muscles were in such a state of tension that, upon the slightest movement of arms or legs, clonic spasms occurred, though none was present when he lay perfectly relaxed, which, however, his exceedingly-nervous condition would not allow him to do. If he tried to sleep, he would be seized with hallucinations just before losing consciousness, imagining that disasters were about to overtake him and seeing all kinds and shapes of images and objects.

Then he would start up with fright and find himself in the greatest nervous excitement. When he stood up, he could close his eyes or look at the ceiling without wavering. His knee-jerks were slightly exaggerated, but sensation was perfect.

> Case in which 2 cupfuls of an infusion made of 2 handfuls of coffee produced intense general tremors, lasting, in spite of bromide treatment, twelve hours after all other symptoms had disappeared. Cohn (Therap. Monats., Mar., '89).

Therapeutics.—Coffee infusion is a most valuable stimulant for cases of narcotic poisoning, opium, belladonna, chloral, etc. While it may prove effective when administered by the mouth, it acts with far greater rapidity when administered by rectal injection. It may be given *ad libitum* in such cases, and its effects will appear sooner in proportion as the infusion is strong.

The rapidity of absorption is enhanced if the temperature of the infusion approximates that of the intestine (100° F.), since cold or heat produce momentary shock from which the intestinal walls must recover before the absorption can begin. (Sajous.)

In the collapse of anæsthesia, the toxic effects of venomous stings and bites, it is an invaluable adjuvant when employed by rectal injection. It sustains all the vital functions while the poison is exerting its effects, and carries the patient through the ordeal.

Caffeine.

Caffeine should be obtained from the dried seeds of coffee, but the caffeine of the drug-stores is really theine, since it is cheaper to manufacture the alkaloid from damaged tea than coffee. It occurs as long, fleecy crystals, silky in appearance, having no particular odor and bitter to the taste. It is soluble in 80 parts of water and fixed proportions of ether, chloroform, and very soluble in boiling water. Caffeine is closely allied to theobromine, found in cacao, coca, and other plants.

Administration and Dose. — Citrated caffeine is frequently employed, owing to its greater solubility; but, Tanret having shown that the addition of equal proportions of the benzoate or salicylate of sodium caused a marked increase of solubility, this mode of prescribing the drug is now often used.

The following is recommended by Huchard for hypodermic use:—

℞ Caffeine, 40 grains.
Benzoate of sodium, 45 grains.
Distilled water, 1 $^1/_2$ drachms.

M. Of this mixture 2 $^1/_2$ drachms are to be administered at each injection.

The citrate is prepared by dissolving 50 grammes of citric acid in 100 cubic centimetres of hot distilled water, adding 50 grammes of caffeine, evaporating to dryness, and powdering finely. The dose is from 1 to 5 grains.

A pleasant preparation is the effervescent citrated caffeine (U. S. P.), made by "triturating together 10 parts each of caffeine and citric acid, 330 of sodium bicarbonate, 300 of tartaric acid, and 350 of sugar, making the powder into a paste with enough alcohol to make 1000 parts, passing the paste through a No. 6 sieve, drying it, and reducing it to a coarse powder. It must be kept in well-stoppered bottles." The dose is from 1 to 3 drachms.

Physiological Action.—Cohnstein has formulated the following conclusions, which agree with those of most observers: 1. In small doses caffeine produces an increase of the arterial pressure, while larger amounts prevent this increase. 2. The influence upon the blood-pressure is the result of the changed condition

of irritability of the vasomotor centre, caused by the caffeine. 3. Caffeine has a direct action on the heart, showing itself in the pulse-frequency and wave-height, first as an irritation and then as a paralysis. 4. The heart-muscle is affected by caffeine in precisely the same manner as the skeletal muscle.

As to the effects of caffeine on blood-pressure, Gaetano Vinci found that in all cases there was a rise of blood-pressure, whether the drug was administered by the mouth, intravenously, or hypodermically, with a consequent fall of pressure only in rabbits. In dogs and rabbits subjected to repeated blood-lettings, there was a constant rise to the normal, and often far above. In dogs suffering from inanition there was a constant elevation of blood-pressure proportionate to the weakness of the animal, except in cases where the lowering of vital forces had gone so far as to affect the heart-muscle.

Schneider found that after therapeutic doses caffeine could not be detected in the urine of cats or men, but that after comparatively-large doses it was readily obtained. Contrary to the opinion of Maly and Andreasch, he thought that the greater part of the drug was destroyed in the body. The discrepancy in the results of these various investigators may have been due, according to C. R. Marshall, to differences in the dose administered, the animal used, or the methods of estimation of the alkaloid employed.

> Caffeine acts chiefly as a stimulant to the nervous system. In this manner it affects the action of the heart, causing the beats to become stronger, and in some cases more rhythmical; but, unlike digitalis and strophantus, it has no specific action on the inhibitory nerves of that organ. Its action on the vasomotor centres is marked, causing contraction of the vessels and increased tension in the same, the blood-pressure rising. Pawinski (Zeitsch. f. klin. Med., B. 23, H. 5, 6, '94).
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> Caffeine facilitates muscular labor by increasing the activity not of the muscle itself, but of the corresponding cerebrospinal centre. As a consequence of this double action on the cerebrum and medulla, the sensation of effort is diminished and keeps off fatigue. The drug further prevents loss of breath and palpitation due to severe muscular effort. It does not check tissue-waste. Caffeine allows more exertion through a kind of physiological economy. The drug would seem to place a person untrained in the position of one who had been subjected to perfect physical training. The ingestion of food allows of a certain amount of exertion, but fatigue comes on before the assimilated products of digestion are used up, and thus a reserve is left. Caffeine seems to use up more or less of that reserve, and hence the drug is beneficial only temporarily. Germain Sée and Lapicque (Bull. de l'Acad. de Méd., Mar., '90).

Caffeine is thought by some observers to be one of the drugs instinctively desired by man, because of its exciting influences. Caffeine in small, repeated doses, according to this view, may be advantageously prescribed to soldiers on the march, as it increases muscular action and promotes the activity of the motor-nervous system, both cerebral and medullary. The result of this double action is to diminish the sensation of effort and to prevent fatigue. It prevents shortness of breath, with resultant palpitation. In this manner it supplies vigor to one who is engaged in severe and prolonged exercise.

> Theine is much used as a substitute for caffeine; this may account for the palpitation of the heart, which has greatly puzzled recent observers. Editorial (Therap. Gaz., Oct., '89).

Poisoning by Caffeine.—James Ferguson observed a case of tonic spasm following a medicinal dose of citrate of caffeine,

repeated three hours later for severe headache, which became more violent than before. There was jerking of the hands and forearms, the fingers began to be rigidly clenched, and shortly after the head was seen to be drawn to one side, with the jaws tightly fixed together. At this stage the author found the fingers of both hands as described, and the muscles of the face tightly drawn, but with some imperfect articulation by this time possible. Friction of the affected parts did some good, and a dose of 30 grains of chloral was ultimately followed by recovery of control over the muscles. There had been no loss of consciousness throughout. The patient's sensation had been chiefly one of great faintness and nausea. The author suggests that the use of the drug be watched, since it has now become a popular remedy for headache.

Therapeutics.—European observers—Huchard, Ferrara, and others—state that caffeine, given by the mouth, does not, even in large doses, show its best effects, because it is eliminated with great rapidity. The hypodermic method is the best, and is painless, producing no cutaneous reaction.

In diseases of the heart—both those depending on degenerative processes in the muscular fibres and such as are termed functional—the action of caffeine is striking and beneficial. In these affections the use of digitalis is only indicated during a later stage of the disease, when the heart is no longer capable of fulfilling its duties, when œdema and dyspnœa have set in. Caffeine is further of great use in attacks of dyspnœa, such as are observed in cases of sclerosis of the coronary arteries, and also in cases of cardiac insufficiency following on overexertion, severe moral shock, or febrile maladies.

Very threatening case of cardiac disease in which, after digitalis had entirely failed to give relief, caffeine both strengthened the force of the heart and produced diuresis. Huchard (La Semaine Méd., July 18, '88).

Dropsy.—In dropsical effusions resulting not only from heart affections, but from disorders of other viscera, the diuretic properties of caffeine frequently manifest themselves advantageously.

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Case of chronic peritonitis in which, under pure caffeine, there was always observed a markedly-increased diuresis, but with caffeine sodium salicylate the opposite effect was seen, the caffeine diuresis being suppressed by the salicylate. Caffeine produced its most marked effect after a course of small doses of salicylates. The use of caffeine alone made tapping of the ascites unnecessary, owing to the absorption of all the œdema, which, on the other hand, was increased by the use of salicylates. Caffeine recommended with or without digitalis in all cases of venous engorgement with intact kidneys in order to remove the œdema by diuresis. Siegert (Munch. med. Woch., May 25, '97).

In cardiac dropsy digitalis is the most useful drug, but when it does not afford relief caffeine may be of valuable service. Case in which the heart was greatly enlarged, and the impulse strongly marked, the apex-beat being in the seventh space in the anterior axillary line. There were signs also of dilatation of the aorta. At the apex was a loud and long systolic murmur. The caffeine was used according to the following formula:—

℞ Caffeinæ, 5 grains.
Sodii salicyl., 4 grains.
Aq., ad 1 ounce.—M.

Given twice daily, this mixture afforded considerable relief. Tickell (Clinical Journal, Feb. 2, '98).

Febrile Maladies.—As a stimulant in febrile diseases, enteric fever, pneumonia, scarlatina, diphtheria, etc., caf-

feine is of great value. It supports the patient's vital powers and the cardiac action, and assists him in resisting the tendency to collapse.

> Caffeine is very valuable as a cardiac stimulant in the post-febrile stage of typhoid. Two to 4 grains every four hours should be given. J. B. Walker (Annual, '90).
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> The adynamic state of typhoid fever and pneumonia is favorably influenced by hypodermic injections of caffeine. Benzoate of soda is added to the aqueous solutions of caffeine, and as much as 30 to 45 grains in six to ten injections may be given daily without bad results. Henri Huchard (Revue Gén. de Clin. et de Thér., June 20, '89).
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> Caffeine is indicated in acute fibrinous pneumonia whenever there are signs of cardiac failure; its administration should be commenced, if possible, before collapse develops. In infants, old persons, drunkards, and where there are valvular lesions it should be exhibited from the first. It diminishes the frequency of respiration and pulse, increases the arterial pressure, lessens the temperature, and improves the subjective sensations of the patient. In threatening cases a more rapid effect may be obtained by giving it hypodermically, though it acts speedily by the mouth. Caffeine is also valuable in atelectasis, hypostatic congestion of the lungs, and in emphysema. Te Gempt (Berl. klin. Woch., pp. 504, 527, '88).
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> In acute diseases of children it is to be recommended as a remedy *par excellence*, children supporting it better than any other. Subcutaneous injections to administration by the mouth preferred, 6 grains being given daily in two injections. Bruneau (Thèse de Paris, Feb., '94).

Bronchial Affections.—Caffeine is valuable in bronchial asthma and in bronchitis associated with spasm of the bronchial tubes. When a paroxysm of asthma is present, Skerritt gives 5 grains of the citrate of caffeine every four hours until relief follows. When the attacks come on regularly in the early morning, a dose of 5 or 10 grains at bed-time often serves to avert them. No ill effects have followed the treatment, even when continued for years. The drug sometimes causes slight wakefulness, but, as a rule, patients go to sleep without difficulty after the nightly dose of 5 or 10 grains.

Cephalalgia.—The various forms of headache, dependent upon nervous exhaustion, and the migraine of neuropathic subjects, are generally relieved by effervescent citrate of caffeine. It may be advantageously combined with antipyrine or the bromides.

COLCHICUM.—*Colchicum autumnale*, or "meadow-saffron," is a native of Europe and Great Britain, and constitutes a remedy of great repute abroad, though in America it, of late years, has fallen largely into disuse, not through any lack of intrinsic therapeutic worth, but because of the number of new substitutes offered. Indeed, the drug appears to have passed entirely out of the recollection of the majority of teachers, as they are so unfamiliar therewith as to deny it proper attention.

Both the bulb of the root (corm) and seeds are employed medicinally, and any choice between the two probably lies with the former, inasmuch as it yields more of the alkaloid colchicine. The corm is about one inch long, ovoid, flattish, with a groove on one side, wrinkled and of brownish hue, internally white and solid; inodorous, with sweetish, bitter, acrid taste. It often appears as cruciform transverse slices breaking with a short mealy fracture—if very dark hued, or it breaks with a horny fracture, it is inert, and consequently useless. It yields its virtues to alcohol, but not so readily or completely as to vinegar and wine.

The seeds are at their best during late July and early August, which is the period of collecting. They are nearly spherical, one-eighth inch in diameter, of reddish-brown hue externally, white internally, and yield much the same bitter, acrid flavor as the corm.

Colchicein is a decomposition product of colchicine, and is had as small, yellow needles; soluble in alcohol, ether, and chloroform; slightly so in water.

Colchicine appears both as an amorphous body and a yellow, crystalline powder melting at about 296.5° F.; insoluble in water, alcohol, ether, and chloroform; it is very bitter and highly toxic.

Colchicine tannate is a yellow powder, soluble in alcohol only.

Preparations and Doses.—Colchicum abstract (root, corm), 1 to 2 grains.

Colchicum extract, fluid (root), 2 to 8 minims.

Colchicum extract, fluid (seed), 3 to 10 minims.

Colchicum extract, solid (root), $^1/_2$ to 2 grains.

Colchicum extract, solid (root), acetic, $^1/_2$ to 2 grains.

Colchicum, powdered (root), 2 to 6 grains.

Colchicum, powdered (seed), 3 to 10 grains.

Colchicum-syrup, 1 to 4 drachms.

Colchicum tincture, acetated (root), 10 to 60 minims.

Colchicum tincture (seed), 10 to 30 minims.

Colchicum-wine (root), 10 to 60 minims.

Colchicum-wine (seeds), 30 to 120 minims.

Colchicein, $^1/_{130}$ to $^1/_{64}$ grain.

Colchicine, $^1/_{130}$ to $^1/_{30}$ grain.

Colchicine tannate, $^1/_{64}$ to $^1/_{16}$ grain.

Scudamore's mixture (carbonate of magnesia, 2 drachms; Epsom salt, 8 drachms; wine of colchicum, 4 drachms; peppermint-water, to make 12 ounces), 4 to 8 drachms.

Larger doses of wine may be employed, but the drug then becomes very actively purgative and likewise emetic.

Physiological Action.—In small doses colchicum is a marked alterative and cholagogue, and further exercises some mysterious, but specific, action whereby it becomes sedative, and which cannot be accounted for, save in part, by its evacuant properties. It increases secretions generally, particularly those of the liver and the glands and mucous follicles of the intestines. In large doses it purges copiously, and may likewise prove violently emetic; yet many people will tolerate unusual quantities without any unpleasant effects. Again, it is not uncommon for colchicum to produce a marked degree of exhaustion—perhaps even to fatality—ere hypercatharsis and hyperemesis give warning that it is being pushed too far. The stools produced by the drug are of a highly-bilious character, and, while at first solid or semi-solid, perhaps enveloped with mucus, later they are soft, liquid, of high color, and may even assume a dysenteric character. Authorities are not in accord as to the diuretic powers; while some insist that it favors solution and excretion of uric acid and urea, others deny any such action. As a matter of fact, the drug does not always provoke diuresis; but this is to be accounted for, perhaps, by the character of the preparation employed or the mode of administration. Strange to say, alcohol inhibits the action of colchicum, yet the wine is the most active of all the Galenical preparations. Alkalies materially assist its diuretic and purgative properties, and, combined with potassium bicarbonate,

not only is this observed, but also the antilithic powers of the latter are greatly enhanced.

Colchicum is one of the most valuable remedies in the uric-acid diathesis, and the prejudice against it is absurd; and, far from it being a vascular depressant, it often gives strength and regularity to a feeble and irregular pulse, especially in chronic gout with acute exacerbations. Burney Yeo (Brit. Med. Jour., Jan. 7, '88).

One of the very good reasons why it has failed in many hands is that it is generally given in purgative doses, which prevents its specific effects upon the circulation. In acute rheumatism or gout the circulation should be reduced with aconite or veratrum before giving colchicum.

The drug in moderate doses stimulates all the secretions; but it is not uniform in its effects upon the kidneys. Nevertheless, as an antilithic it is very certain, but may, with advantage, be combined with other remedies. Goss ("Mat. Med., Phar., and Special Ther.," '89).

Acts powerfully on the stomach and intestinal canal, and paralyzes the central nervous system. Death occurs through paralysis of respiration or, according to some, the heart. Roth ("Modern Mat. Med.," '94).

In small therapeutic doses produces gastro-intestinal disturbances, the symptoms differing in degree only from those of poisoning. Before they come on, however, there is a lowering of the pulse-rate, sometimes as much as twelve beats per minute. Upon the skin it acts occasionally, producing, in some cases, diaphoresis, and, it is believed, the amount of this action is in inverse ratio to the effect upon the bowels. Any nervous symptoms, such as vertigo, headache, and muscular weakness, which may be present as the result of the colchicum, are probably sympathetic upon the gastro-intestinal irritation. It is evident that the drug influences the bowels powerfully, and probably in this way acts as an eliminative. But, with the minute doses often used with advantage in the disease, purging does not occur, and consequently increased elimination, if it takes place, must be through the kidneys; great interest, therefore, attaches to the influence of the remedy upon the urinary secretion. In considering this the effects of poisonous and therapeutic doses must not be confounded, for it is very evident that an irritation which causes suppression of urine may, when present in a much milder degree, produce an increased flow. When the drug purges freely it is very probable that elimination by the kidneys is lessened; and no account of this is taken by any of the observers who have studied its effect in the elimination of urea and uric acid; all content themselves with noting the proportion of urea and uric acid in the urine, when it is evident that the mere proportion, unchecked by the absolute amount of urine excreted in the twenty-four hours, is no criterion as to the absolute amount eliminated. H. C. Wood ("Therapeutics: Its Principles and Practice," '94).

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By some observers it is stated that there is an increased elimination both of urea and uric acid, while by others it is denied. It is possible that difference in dietary of the patients may account for this discrepancy. Murrell ("Manual of Materia Medica and Therapeutics," '96).

Full medicinal or larger doses produce great depression of the circulation, with a small, rapid, and thready pulse. The marked cardiac depression and collapse which occur when poisonous doses have been taken, are more the result of the severe gastro-enteritis than of any direct action upon the heart. The nervous system is unaffected by medicinal doses; but large or poisonous doses may induce cerebral excitement. Large doses render the respiratory movements slow and shallow. Personal experiments are sufficient to satisfy the author that the excretion of urea and uric acid by the kidneys is considerably heightened under medicinal doses. Butler ("Text-book of Mat. Med., Pharm., and Ther.," '96).

Colchicum induces fall of temperature during the period of emetocatharsis; when injected into dogs there is a marked fall in blood-pressure. The amount of urea and uric acid excreted in the urine is much increased by the drug; Lewins found the urea excreted to be almost doubled in amount. Biddle ("Mat. Med. and Ther.," '96).

The most discordant statements have been made about the action of colchicum upon the renal secretion, but it has not been definitely shown that either the quantity or composition is altered. After death by poisoning, the alkaloid is found in the blood and in most of the organs of the body. Hale White ("Mat. Med., Phar., and Ther.," '96).

Though the physiological effects of this drug are very similar to those of veratrum, yet one cannot be therapeutically substituted for the other. It produces much irritation of the fauces with increase of saliva, sometimes in such quantity as might be well termed ptyalism. It is irritant to the stomach and intestines, and produces these effects, whether taken into the stomach or injected into the veins. In large doses it considerably increases biliary secretion, and at the same time purges powerfully.

According to some, colchicum acts most serviceably in gout and rheumatism when it purges, but others hold purgation to be not only unnecessary, but injurious. There is no doubt that purgation is not necessary. It enters the blood speedily, and in full doses soon excites a feeling of warmth at the stomach, with a glow and outbreak of perspiration over the whole surface of the body, together with throbbing of the vessels, and reduction of the force and frequency of the pulse. Though reputed diuretic, and to stimulate the secretion of a large quantity of urine even in healthy persons, this has not been confirmed; observations show that, if it acts at all on the kidneys, it rather lessens the amount of water, urea, and uric acid.

[Ringer bases this statement on the observations of Garrod and of Bocker, which date from 1857-'58, at the same time ignoring later evidence of equally positive and opposite character. The real truth will probably be found by studying the drug in varying doses in precisely parallel conditions, which has not yet been done. Note also the observations of H. C. Wood (*ante*). Personally, I agree with Yeo, Butler, and Biddle, with the same reservation as that offered by Murrell. STOCKWELL.]

Colchicum, it is well known, gives relief from the pain, inflammation, and fever of gout. But how? Does it cause the elimination of uric acid through the kidneys and so remove the condition on which the gout immediately depends? Since Garrod has experimentally shown that colchicum exerts no influence on the elimination of uric acid in gouty people, it is evident that the drug must control gouty inflammation without, in any way, affecting the condition on which such inflammation, in the first instance, depends. Hence, colchicum should be merely palliative, removing, for a time, the patient's sufferings, but in no way protecting him from their recurrence. Many who suffer from gout are of opinion that, while the medicine will remove altogether an existing attack, it insures the speedy return of another. Ringer and Sainsbury ("Hand-book of Ther.," '97).

Colchicine in a general way acts like colchicum, but the action of colchicein has not been determined with any degree of definiteness.

On the heart and circulation colchicine produces very little effect, though large doses cause a fall of arterial pressure and slight slowing of pulse, due to depression of the heart.

Colchicein, in poisonous doses, induces marked weakness, stupor, and lowering of bodily temperature; decreases reflex activity, not by depressing the sensory nerves as does colchicine, but by acting on the motor nerve-trunks. Leon (Univ. Med. Mag., July, Aug., '89).

Two or three hours after the intravenous injection of colchicine the symptoms of general poisoning appear. The first symptoms are nausea, followed by more or less vomiting and diarrhœa;

next, alteration in the motility, taking on the form of ascending central paralysis. When the paralysis reaches the anterior extremities, disturbance of respiration occurs: the respiratory movements become greatly increased in power and greatly decreased in number, until death ensues, owing to arrest of respiration. In rare cases, immediately before death, convulsions occur, which are attributable to asphyxia. The heart remains beating for perhaps twenty minutes after breathing has been arrested. Jacobi (Schmidt's Jahrbuch, Sept.; Therap. Gaz., Oct., '90).

Colchicum and its salts are contra-indicated when there is a great amount of debility, a profuse diarrhœa, and in asthenic gout. It is worthy of remark that most of the untoward effects chronicled from time to time have appeared in conjunction with the administration of wine of colchicum-seed. On the other hand, much of the corm, or "root," employed by manufacturers is worthless.

Therapeutics. — RHEUMATISM AND GOUT.—In all forms of sthenic rheumatism and gout the relief that colchicum gives is incomparably greater than that afforded by any other single remedy, but the mode in which it is best given, the period best suited for its administration, and even the patients for which it is suited are points which demand serious consideration. It is by no means an agent to be prescribed hap-hazard and indiscriminately, nor one which will, in all cases, produce equally beneficial results. The maxims laid down by Todd cannot be improved upon, viz.: Never give it at the outset of a paroxysm, not until the bowels have been acted upon by a mild purgative. Let the first doses, always, be small, and subsequently gradually and progressively increased. At first administer uncombined with any other remedy until assurance is had that it is not likely to disagree with the patient; and do not push to a degree that will excite nausea, vomiting, or purging: these should be regarded as indicative of unfavorable operation. It may be regarded as acting favorably when, under its use, the volume of urine is increased; when an abundant supply of bile is discharged; when the fæces, though solid, are surrounded by mucus; and when the skin secretes freely. Its effects should be carefully watched, as it is likely to accumulate in the system. It is inadmissible where the patient is advanced in years, who has had several attacks and in whom the malady seems too deeply rooted to be influenced by the temporary administration of the remedy.

It is necessary to continue the use of colchicum for many days after the entire cessation of the symptoms; but the doses may be gradually diminished, and at the same time the intervals lengthened; also, if the malady does not give way by the time the bowels are affected by the drug, it is useless to push it further.

A remedy for gout, more especially the acuter forms, and here it never fails to remove pain speedily, without, however, in any way lessening the tendency to future attacks. It is also very valuable in various diseases of gouty parentage, as in some forms of dyspepsia, bronchitis, etc.; but in acute rheumatism it has been proved to exert rather a noxious than a beneficial effect. Farquharson ("Guide to Ther. and Mat. Med.," fourth edition, '89).

Colchicum is a remedy of positive action in many cases, but possesses the objectional quality of being very debilitating through its action on the heart and bowels. Though not so generally applicable to rheumatism as to gout, it acts promptly in the treatment of tearing muscular pain, either acute or chronic. It combines well with cimicifuga in such cases, the combination not impairing the action of either remedy. Webster ("Dynamical Ther.," '93).

Its action in acute and chronic gout,

as also in rheumatic affections of all kinds, is unreliable. Roth ("Modern Mat. Med.," seventh edition, '94).

Gout is the one disease in which colchicum is almost universally recognized as a specific. It may be advantageously employed both as a preventive of the paroxysm and to lessen its severity when developed. It should always be borne in mind that, although looseness of the bowels may be useful, yet when colchicum purges the gouty patient actively it mostly fails in achieving the desired therapeutic result. Its action is most favorable when its influence is felt chiefly upon the skin and kidneys; and to effect this it is often well to restrain the tendency of the drug to act upon the bowels by combining it with opium. This is especially the case in debilitated subjects, in whom anything like overpurgation must be avoided with the most scrupulous care. By large purgative doses of colchicum the paroxysm of gout may often be suppressed, but experience has shown this use of the drug is dangerous, the suppression being sometimes followed by serious internal diseases, apparently due to a transfer of the gouty irritation. Between the paroxysms colchicum may be steadily exhibited to the gouty subject in small doses, and often great advantage is derived from its combination with potassium iodide; this combination is especially useful in irregular atonic gout such as is frequently seen in women of feeble nervous organization who have inherited the diathesis, but is sometimes present in robust men.

In the inflammatory variety of rheumatism colchicum is of but little value except in purgative doses. In subacute rheumatism the combination with potassium iodide is very useful. H. C. Wood ("Therapeutics: Its Principles and Practice," ninth edition, '94).

In gout striking effects follow its administration, pain subsiding promptly, swelling disappearing, and the attack often vanishing after one or two doses. Some, however, believe that it is in no way curative, the relief being dearly bought, the pain returning with greater severity. Whitla ("Mat. Med. and Ther.," seventh edition, '94).

It is better to reserve colchicum for the treatment of the acute paroxysms of gout, giving a little opium (as in Dover's powder) at night, particularly to relieve the pain and to procure sleep, enjoining perfect rest and quiet and using warm applications locally. In chronic gout and the uric-acid diathesis it is not as useful. Biddle ("Mat. Med. and Ther.," thirteenth edition, '95).

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While efficacious in chronic rheumatism and occasionally of some benefit in rheumatoid arthritis, it is of no value in acute articular rheumatism. Its value is more apparent in acute than in chronic gout, and in the first attacks than in succeeding ones. Chronic gout, as well as chronic rheumatism, yields better to a combination of potassium iodide than to colchicum alone. In combination with certain other agents this drug serves an excellent purpose as a cholagogue, full doses being frequently very effective in relieving ascites due to obstructive diseases of the liver. It is also sometimes employed as a drastic purgative in cerebral and portal congestion, although when given in doses sufficient for this purpose it occasions considerable nausea and abdominal distress. It has also been recommended in the treatment of gonorrhœa and chordee. Hypochondriasis resulting from renal insufficiency is frequently benefited by this remedy. Butler ("Text-book of Mat. Med., Ther., and Phar.," '96).

Given during an attack of gout it most markedly relieves pain; in smaller doses, given between the attacks, it diminishes their severity. It is often very useful for dyspepsia, eczema, headache, neuritis, conjunctivities, bronchitis, and other conditions which, when occurring in those suffering from gout, are probably related to it. Occasionally it is combined with other cholagogues, especially if it is desired to give these remedies to a person who is the subject of gout. Hale White ("Mat. Med. and Ther.," '96).

Colchicum is a remedy of undoubted value in gout and the gouty diathesis. The larger doses of the drug should be reserved exclusively for able-bodied men of the brewer's-drayman kind, and the effect is marvelous, the patient usually being able to resume work on the third day; but the treatment is severe and produces persistent purging not uncommonly accompanied by vomiting. In less severe cases give 10 minims of colchicum-wine with 5 grains of potassium iodide in a mixture flavored with spirit of chloroform and syrup of orange-flower, three times a day; this often acts as a laxative, and produces a peculiar metallic taste in the mouth; many patients take this mixture at intervals all the year round. Murrell ("Manual of Mat. Med. and Ther.," '96).

The effect of colchicum on gouty inflammation is very rapid; a large dose will often relieve the most severe pain in the course of one or two hours, and soon afterward the swelling and heat will subside. While the pain is thus quickly subdued, the temperature of the body falls very little during the first day, but on the following morning there is generally a considerable decline, and often a return to a healthy temperature; should the fall be postponed a longer time, then on the second day after the use of the colchicum a continuous decline of temperature will take place, and all fever gradually disappear. There are two methods of employing the drug: large doses which extinguish the pain at once, and small doses which give the same result only after some days. It is sometimes used in chronic rheumatism and rheumatoid arthritis, but without any very apparent benefit. Ringer and Sainsbury ("Hand-book of Ther.," thirteenth edition, '97).

General Maladies.—In dropsies—the anasarca of the aged, hydrocephalus, hydrothorax, anasarca following fevers, etc.—colchicum is often very efficacious, especially in combination with other diuretics and a diuretic alkali. It is one of the most satisfactory remedies in chronic and obstinate constipation, but the dose should be small, as the object is attained rather by gradual insinuation than by forcible impression. In gonorrhœa and other inflammatory discharges from the genito-urinary organs, in both sexes, in strangury, ardor urinæ, and irritable states of the bladder, it has been employed with great success. At one time it was held to be the most efficient agent known to therapeutics in removing tape-worm. In jaundice and chronic hepatitis it has a value, but requires to be combined with soap, alkalies, or mild mercurials.

Spasmodic attempts have been made toward popularizing the alkaloid colchicine, but with little success; it does not sufficiently represent the virtues of colchicum. It has found its best application in the treatment of rheumatic iritis, and its value here is greatly enhanced by combining with methyl-salicylate. It has also been employed subcutaneously in chronic rheumatism and neuralgic joint-affections.

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A valuable remedy, and in conjunction with small doses of calomel may be prescribed with advantage for gouty people who have had no acute manifestation of the disease, but who suffer more or less continuously from joint-pain. A pill may be taken at bed-time, or three times a day after meals, composed of: $^1/_{60}$ grain of colchicine, $^1/_2$ grain of calomel, and 1 grain of solid extract of henbane. In gouty neuritis a pill three times daily—of colchicine, $^1/_{60}$; quinine and extract of colocynth, of each, 1 grain—is recommended. Murrell ("Manual of Mat. Med. and Ther.," '96).

For hypodermic use the alkaloid may be dissolved in distilled water in the proportion of 1 to 560 minims, the dose being 15 minims; but the injection causes sharp burning pain. When deep, intramuscular injections have been tried

in sciatica, the results have been unfortunate and unprofitable.

G. Archie Stockwell,
(Central Staff).

COLD ABSCESS. See Abscess.

COLIC, RENAL. See Renal Calculus.

COLITIS. See Intestines.

COLLAPSE OF LUNG. See Pulmonary Atelectasis.

COLOBOMA. See Lids.

COLOCYNTH.—This is the dried, decorticated fruit, freed from seeds, of *Citrullus colocynth*, a perennial plant resembling the watermelon; it is also known as "bitter apple" and "bitter cucumber." Though grown in gardens in England since 1551, the plant is a native of the deserts and places of southern and western Asia, and of Africa; it is likewise cultivated, medicinally, in Greece, Spain, Italy, and Japan. Two varieties of fruit are recognized pharmacologically: one termed "peeled Turkey" colocynth, imported chiefly from Smyrna, Trieste, and Spain, and "unpeeled mogador," from different parts of India, Africa, and, to some extent, from the Persian Gulf and the Levant.

The fruit is globular, about the size of a small orange, yellow and smooth when ripe, and usually gathered just as the latter process is beginning, when it is peeled and dried quickly, either in the sun or by artificial heat. As found in the shops, it is in white balls that are very light and spongy; about three-fourths of its weight is claimed by the seeds, which are not employed medicinally, though sometimes used in small proportions for purposes of adulteration. The British Pharmacopœia demands a test that shall prove the colocynth to be wholly oil-free as evidence that such adulteration has not taken place, since such is a seed-product solely. Colocynth is inodorous, nauseatingly bitter, and yields a glucoside termed "colocynthidin" and a resin known as "citrullin," or "colocynthitin," the latter not being identical, however, with the colocynthitis of Walz.

Preparations and Doses.—Colocynth pulp, powdered, 2 to 10 grains.

Colocynth extract, compound (colocynth, 16; aloes, 50; cardamom, 6; scammony resin, 14; soap, 14; and alcohol, 10 parts), 5 to 20 grains.

Colocynth extract, fluid, 2 to 5 minims.

Colocynth extract, solid, 1 to 3 grains.

Colocynth pills, compound (compound cathartic pills), 1 to 3 pills.

Colocynth pills, compound, with henbane, 1 to 5 pills.

Colocynth tincture (10 per cent.), 30 to 60 minims.

Colocynthidin, $^1/_6$ to $^2/_3$ grain.

Colocynthin resinoid (concentration), $^1/_{40}$ to $^1/_{10}$ grain.

Colocynthitin (citrullin), $^1/_6$ to $^1/_2$ grain.

Powdered colocynth is now but sparingly used, the extract serving a much better purpose.

Compound colocynth, or cathartic, pills, are made in two ways. First by making a mass of compound extract of colocynth, 130; powdered extract of jalap, 100; calomel, 100; and gamboge, 25; to make 100 pills. Second, by beating together colocynth-pulp, 4; Barbadoes aloes, 8; scammony resin, 8 parts; and potassium sulphate and oil of clove, of each, 1 part. It is often used in form of powder in doses of from 5 to 10 grains, and is easily identified by the odor of

cloves. The so-called "vegetable" compound cathartic pill drops the calomel and gamboge, and substitutes leptandrin, resin of podophyllin, henbane, and oil of peppermint.

Colocynth pill with hyoscyamus is made by mixing 2 parts of the compound colocynth pill (second formula just given), with 1 part of solid extract of henbane. It is not so liable to gripe as is the pill colocynth compound, and the dose is the same as the latter: 5 to 10 grains.

The glucoside colocynthidin, which is identical with the *colocynthin* of Merck, appears as a yellow powder soluble in water and alcohol, and is frequently used in enema by mixing from 4 to 16 minims of a 4-per-cent. solution in glycerin and ale.

The concentration colocynthin is obtained by evaporation from an alcoholic tincture as a chocolate-colored powder soluble in alcohol only.

Walz's colocynthitin is a tasteless crystal powder; but citrullin, which often obtains this title, is a yellowish, amorphous powder, soluble in alcohol, glycerin, and ether, and finds more use in veterinary practice than elsewhere, though it is sometimes employed for its cathartic effect, preferably by suppository or in enema, in general medicine.

Physiological Action. — Colocynth preparations and derivatives stimulate the secretions throughout the *prima viæ*, and in full doses are apt to produce considerable irritation of the large intestine, causing profuse watery evacuations. If given in excessive doses, fatality may be induced by provoking inflammation, leading, perhaps, to ulceration. The drastic effects of the drug and its tendency to cause griping are readily overcome by prescribing partly with other purgatives and partly with carminatives, more particularly extracts of henbane or belladonna or monobromated camphor. The drug is likewise actively cholagogic, and to some degree diuretic.

Colocynth Poisoning.—This is, fortunately, very rare, less than a score of cases appearing in literature. Christison describes a case in which a teaspoonful and a half of the powder killed a man, and Huseman mentions an instance where 40 grains proved fatal, though another case of his recovered after 3 drachms had been ingested. The toxic symptoms are hypercatharsis, and evidences of powerful gastro-intestinal irritation. The treatment consists of administering evacuants, demulcents, opiates, and stimulants.

Therapeutics.—This drug is chiefly employed for its stimulating effect upon the liver and the intestines, or when a rapid, efficient, drastic purgative action is desired. It renders the bile more fluid and watery, at the same time increasing the secretion of biliary matter.

Gastro-Intestinal, Dropsical, and Gouty Disorders. — Colocynth is a favorite remedy in habitual constipation and various dyspeptic conditions; but it is contra-indicated, except in minute doses, in inflammatory conditions of the intestinal canal. In dropsical affections, too, particularly when connected with disease of the liver, it is often effective, particularly if a hydragogue action is secured by combining with a little elaterium. In fact, in most conditions accompanied by constipation or visceral obstruction the drug is eligible.

> Colocynth is one of the most prompt and powerful remedies for the relief of enteric colic. It makes some very satisfactory cures in cholera infantum and dysentery, being especially indicated when the disease is attended by intense pain—when pain is a prominent feature of the complaint. And though the drug

seems to influence the circulation of the lower bowel to a marked extent, it is more a remedy for neuralgic than for circulatory disturbances, and relieves neuralgic colic magically in many instances; however, it is adapted to pain in any portion of the alimentary canal below the œsophagus, and will prove useful in many a case of gastralgia of neuralgic character. In minute doses it is serviceable in the treatment of constipation in children and delicate females when other remedies would be objectionable. Webster ("Dynam. Therap.," '93).

Colocynth is never used alone, but always in combination with other drugs of its class, as a hydragogue cathartic. In cases of chronic dropsy, and for the relief of serous effusions, it is generally given in the form of the compound extract. Hare ("Prac. Therap.," '94).

Is a favorite remedy in dropsical conditions to produce watery stools, in cases in which other resorbents are contra-indicated. Roth ("Mod. Mat. Med.," '95).

Is a good remedy in passive dropsy from visceral obstruction provided the patient is not debilitated; also in dyspepsia when there is a bitter taste in the mouth, bloating of the stomach after eating, and colicky or sharp, cutting pains in the region of the umbilicus. For bilious or worm colic it is a very important remedy; likewise in many diseases of the liver. It does good service in chronic diarrhœa when the stools are slimy and attended with sharp cutting pain and distension of the abdomen. It is serviceable in some cases of dysentery and again in neuralgias of the fifth nerve. Locke ("Mat. Med. and Therap.," '95).

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Colocynth is an excellent purgative for producing a single abundant evacuation of the bowels in chronic constipation, such as that so often met with in persons suffering from hepatic disorder, and in those confined to bed. Because of the watery character of the motions it may be given in ascites or Bright's disease. It should never be administered if there is any suspicion of intestinal or gastric inflammation, nor in pregnancy. Hale White ("Mat. Med. and Therap.," '96).

In small doses the drug acts as a stomachic, improving the appetite and augmenting the secretions of the whole gastro-intestinal tract; it is also a decided hepatic stimulant and cholagogue, and useful to produce abundant watery evacuations, as is necessary sometimes in the treatment of hepatic and renal diseases where there is constipation and ascites. Gastro-intestinal inflammation, pregnancy, etc., contra-indicate its use. Butler (Text-book of Mat. Med., Therap., and Pharm.," '96).

The drug has been used to cause the disappearance of long-continued dropsies and fluid effusions, but this employment is not to be recommended. Griffin (Foster's "Prac. Therap.," vol. i, '96).

Apoplexy, Mania, and Cerebral Affections.—Here the drug is often particularly useful as a powerful cathartic and derivative, but requires to be exhibited in full doses and repeated until it operates freely. Croton-oil is generally preferred, however.

Hypodermic Administration.—The claim has been repeatedly advanced that the glucoside, given subcutaneously, is actively purgative. Some experiments, lasting several months, undertaken for definitely proving or disproving this, were undertaken by responsible persons, in the laboratory of a large firm of manufacturing pharmacists and chemists, and the evidence was wholly negative.

G. Archie Stockwell,
(Central Staff).

COLON, DILATATION OF. See Intestines.

COLPITIS. See Vaginitis.

COLPOPTOSIS. See Vagina.

COMEDO. See Acne.

COMPOUND FRACTURES. See Fractures.

COMPRESSION OF BRAIN. See HEAD, INJURIES OF.

CONCUSSION OF BRAIN. See HEAD, INJURIES OF.

CONDYLOMA. See SYPHILIS.

CONGESTION OF LUNGS. See BRONCHITIS and PNEUMONIA.

CONIUM. See HEMLOCK.

CONJUNCTIVA, DISEASES OF THE.—The conjunctiva is more frequently inflamed than any other ocular tissue; it is not only exposed to invasion by hosts of bacteria, but it offers a favorable *nidus* for their development. The pathogenic micro-organisms may be carried into its folds in many different ways: through the medium of the hands, towels, handkerchiefs, etc., through the lacrymal passages, and from the nasal mucous membrane by direct continuity of structure.

Tears have the power of diminishing the number of the staphylococcus pyogenes aureus and the bacillus subtilis. Their virulence, however, is not affected. The gonococcus and micrococcus prodigiosus were unchanged. Bernheim (Corres. f. schweizer Aerzte, Aug. 1, '93).

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Investigations of one hundred healthy eyes. The normal conjunctiva always contains bacteria, among which the staphylococcus epidermis albus is found with such frequency that it must be regarded as a regular inhabitant of the conjunctival *cul-de-sac*. This coccus, though but slightly pathogenic ordinarily, may, under certain conditions, become harmful. Neither irrigation with distilled water nor instillation of a 1 to 5000 solution produces sterility of the conjunctiva. R. Randolph (Arch. of Ophth., July, '97).

Hyperæmia of the Conjunctiva.—Conjunctival hyperæmia may either be passive or active. Passive hyperæmia exists after paralysis of the cervical sympathetic, or as a result of some interference with the proper circulation of blood in the membrane, or it may be associated with disorders of the general systemic condition, especially gout.

Active hyperæmia is a prelude to all inflammatory conditions of the conjunctiva, but may be occasioned by the presence of a foreign body or a misplaced cilia, or by the irritative action of dust and smoke. It is a frequent exponent of some error of refraction or of muscular insufficiency, and is often associated with a catarrhal condition of the nose and throat and with disease of the lacrymal passages.

Symptoms.—There is a smarting, burning, and itching sensation in the eyes, the lids feel heavy, and there is a disinclination to prolonged near and fine work. On eversion of the eyelids the mucous membrane is found to be abnormally red and perhaps a little swelled, while the Meibomian glands, imbedded in the tarsus, are rendered indistinct by dilated meshes of blood-vessels. The injection of the vascular supply may be limited to the conjunctiva of the lids or involve that of the globe also. There may be a slight increase in the flow of tears, but there is never any discharge.

Treatment.—Treatment of hyperæmia of the conjunctiva resolves itself into the removal of the cause. If of passive origin, the removal of the obstruction to the circulation will be followed by the rapid subsidence in the undue vascularity. If of active, the correction of any existing anomaly of refraction or of muscle-balance, or the removal of any foreign body, will accomplish the same result. Dark glasses should be given to protect the eyes from irritating rays of light, and from dust and smoke, and a

boric wash or some other mild antiseptic or astringent lotion will, with cold compresses, be sufficient to reduce the vessels to their normal size.

Inflammation of the Conjunctiva.—When an increased and perverted secretion is added to the symptoms of hyperæmia, the conjunctiva may be said to be inflamed.

All varieties of conjunctivitis are contagious, and, while they occasion certain fixed changes in the tissues, which permit of their being grouped into certain types, they have this peculiarity, that the secretion from one type when inoculated into a healthy eye may set up quite a different variety of conjunctival inflammation from that of the eye from which it was obtained; showing that the secretion of the different forms cannot be regarded as specific, but that the type of inflammation set up by it depends upon other causes as well.

Corneal involvement is a common complication of all forms of conjunctivitis and must always be regarded in the prognosis, as its occurrence usually indicates that there will be a permanent disturbance in vision after the subsidence of the inflammation.

According to the nature of the secretion and the character of the pathological changes observed in the tissues of the conjunctiva, inflammations of that membrane have been divided into the catarrhal, diphtheritic, purulent, granular, and phlyctenular varieties.

Catarrhal Conjunctivitis.

Symptoms.—In the simple form the conjunctiva is red, vascular, and swollen, the vessels usually forming a large, coarse net-work. At first these changes are limited to the palpebral conjunctiva; but they soon extend to the retrotarsal fold, the caruncle, and semilunar folds, and finally to the bulbar conjunctiva. The surface of the membrane is smooth, serving to differentiate it from other forms of conjunctival inflammation. The eyelids are slightly swelled, and their edges reddened and covered with yellowish crusts, and bathed with an abundant secretion.

Severe cases are characterized by the involvement of the bulbar conjunctiva, and by an increase in the redness and swelling of the palpebral portion of the membrane and of the retrotarsal folds. The net-like formation of blood-vessels can no longer be differentiated; small hæmorrhages appear, scattered through the membrane, and there is a serous infiltration from both the superficial and deep vessels. This fluid collects in the submucous tissue and occasions chemosis.

The lymph-follicles may develop, and the papillæ of the conjunctiva become swelled and turgid and give to the membrane a roughened and granular appearance.

In chronic forms the objective symptoms are not prominent. There is moderate swelling and congestion of the conjunctiva and but slight secretion, the symptoms being those of hyperæmia.

There is a constant sense of heaviness and a sensation of sand in the eyes; there is burning and watering, and vision is momentarily blurred by some of the secretion covering the pupillary area of the cornea.

Complications.—Secondary corneal involvement occurs in the aged, especially when the catarrh has persisted for years. The ulcers are usually at the limbus, and their formation is attended with pain and photophobia. They appear as small, round, gray points, which may become confluent and form a crescentic ulcer. These usually heal, leaving small, bow-shaped nebulæ. Iritis may also present itself, and is usually the result of kera-

titis; but it may also be seen in severe cases of conjunctivitis without involvement of the cornea.

In gouty persons there is a form of conjunctivitis to which the name of "catarrho-rheumatic ophthalmia" has been given, which is attended with great pain in the eyes and temples and great photophobia. There is usually marked lacrymation, but no discharge.

Literature of '96 and '97.

Singular and rare conjunctival affection occurring in arthritic persons, and in those affected with arteriosclerosis, consisting of the onset of an active hyperæmia of the conjunctiva coming on suddenly, without appreciable cause, and disappearing spontaneously, the attacks almost always coming on during the night, lasting three or four hours, and recurring regularly two or three times at intervals of twenty-four hours. M. Trousseau (Recueil d'Ophtal., No. 6, '96).

In four cases small spots on the conjunctiva observed which resembled the infarcts of Weiborn, but found to be mycosic colonies similar to actinomycosis; some yellowish little grains collected into small balls, sometimes covered with epithelium, were also seen. The symptoms were those of a slight conjunctivitis. Scraping sufficed to remove the colonies, but a culture was not obtained. Fuchs (Annal. d'Oculist., Sept., '96).

Etiology.—Catarrh of the conjunctiva may be originated by any of the causes of hyperæmia of the conjunctiva. It may be the product of foul air or of poorly-ventilated rooms, especially when large numbers of people are crowded together, as in tenements, etc.; professions which expose the eyes to overuse or the prolonged action of irritative gases and vapor, dispose to it, or it may be set up by contact with a leucorrhœal discharge. It is common in warm and changeable weather, when it may assume an epidemic form. Staphylococci and streptococci are almost always present, and the diphtheritic bacillus likewise. Weeks has found small bacteria in "pink-eye," which, when inoculated upon the conjunctiva of the rabbit, has produced this form of catarrhal conjunctivitis.

Literature of '96-'97-'98.

Inoculation from a pure culture of Loeffler serum of two medical colleagues, who, four days later, presented all the appearances of the disease. In one the affection spread to the second eye. Axenfeld (Centr. f. Bakter., Parasit., u. Infektionsk., B. 21, No. 1, '97).

"Subacute conjunctivitis" proposed as a name for a frequently-observed variety of catarrhal conjunctivitis caused by a particular micro-organism. It affects all ages, but especially the adult and old age; the onset is sudden and its course is marked with a slight muco-purulent discharge and sensation of smarting, but without actual pain. It is apt to be bilateral and does not go on to corneal complication. It is a benign affection and yields easily to weak solutions of zinc sulphate, but does not tend to spontaneous cure if left to itself. It may be mistaken for light and prolonged conditions of the acute contagious conjunctivitis due to the bacillus of Weeks, which, however, is more often observed among children. The micro-organism is a diplobacillus appearing as two short rods separated by a clear space. Quite long chains are sometimes seen. It differs from the pneumobacillus of Friedländer in having no capsule and being more distinctly rod-like. Like the bacillus of Weeks, it is not pathogenic for animals, but a pure culture carried through the fifth generation after an incubation provokes the typical inflammation in man. Morax (Boston Med. and Surg. Jour., Jan. 6, '98).

The course of this variety of conjunctivitis is usually favorable, uncomplicated cases recovering in from one to two weeks. In adults, however, especially if there be a history of alcoholism, albu-

minuria, or diabetes, the disease may assume a chronic form. Both eyes are usually affected, either at the same time or the second eye a few days later. The disease may begin as an hyperæmia and slowly go over into catarrh, or the onset may be more abrupt. In institutions where there are poor hygienic conditions, the disease usually becomes chronic and epidemic.

Treatment. — Attention should be given to the general health. Any existing systemic disease, such as rheumatism, diabetes, or albuminuria, should be combated, shorter working-hours should be prescribed for professional men and more exercise recommended; the eyes must be properly protected from the light, air, and dust with smoked glasses, and they should be kept clean from discharge by frequent washings with boric-acid lotion; great relief may also be obtained from the application of ice-compresses. These are best applied as follows: 1. Several pads of gauze of three or four thicknesses, about the size of a silver dollar, are laid on a block of ice. The ice should be suspended in a receptacle with perforations in its bottom which will permit the water and any secretion from the compress to drain off into a jar beneath it. An ordinary kitchen-collander and wash-basin will answer very well for this apparatus. One of the pads is taken from the ice as soon as it has been saturated and is applied to the closed lids, removed in a few moments, and a fresh one substituted for it. 2. Compresses of absorbent cotton which have been soaked in ice-water may also be employed. They should be squeezed out sufficiently to prevent any of the water trickling over the patient's face and neck. 3. Cold may also be applied by means of the ordinary douche or by holding a small cake of ice directly to the eye; but these should be discarded for the compress, as they can only be used intermittently.

To avoid repetition it seems well at this place to give the indications which call for the employment of hot and cold compresses, not only in the treatment of catarrhal conjunctivitis, but also of the other forms of conjunctivitis as well.

In hyperæmia of the conjunctiva, induced by ametropia or the presence of a foreign body, we have, in cold, a simple, but effective, means of restoring the membrane to its healthy condition. In these cases the douche or the compress may be applied over the closed lids, with the greatest advantage, for fifteen minutes at a time. The water employed should not be too cold, or excessive reaction may follow its use.

> Frequent washing of the eyelids and surrounding skin with warm water and Castile soap is the most efficacious home-treatment for catarrhal conjunctivitis. De Schweinitz (Phila. Polyclinic, Apr. 7, '94).
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> In the treatment of the milder form of conjunctivitis the membrane may be sprayed with a solution of boric acid and salt, the good effects of this plan being probably due to the fact that the liquid thus applied penetrates the deeper tissues and correspondingly increases the extent of the contact and prolongs the action of the drug. De Schweinitz (Amer. Jour. of Ophth., St. Louis, Jan., '94).

Literature of '96 and '97.

A 2-per-cent. solution of extract of suprarenal capsule will cause a certain amount of contraction of the blood-vessels in an eye not inflamed, while a 3-, 4-, or 5-per-cent. solution will produce a decided blanching of the ocular and palpebral conjunctiva within a couple of minutes after the application is made, even though the engorgement of the vessels be considerable. The contraction of the blood-vessels does not last long, however, and as they begin to dilate they re-

turn gradually to the condition existing before the application was made. Bates (N. Y. Med. Jour., May 16, '96).

A 2- to 4-per-cent. solution of the extract of the suprarenal capsule has a well-marked effect in contracting the blood-vessels of the conjunctiva. Lucien Howe (Moody's Mag. of Med., Aug., '96).

Aqueous extract of suprarenal capsule produces great bleaching of the conjunctiva, but after the astringent action has passed away the inflammation returns in greater force than before. Hansell (Editorial, Phila. Polyclinic, '97).

In the severer forms of conjunctivitis, when there is a purulent inflammation or an exudate, ice is the sovereign remedy. When employed in the manner indicated, disastrous results are not to be feared.

The direct application of ice to the lids affords the best means of getting rid of the chemosis and œdema of both lids and conjunctiva. Foucher (Annals of Ophthal. and Otol., Jan., '93).

At the commencement of the disease the board-like swelling of the disease is, doubtless, one of the chief causes of pyrexia, and, as the swelling and induration prevent the cold from gaining access to the eye, it is necessary that the treatment should be energetic and prolonged. The compresses, therefore, should be maintained night and day in such cases, and should only be desisted from when a corneal ulcer threatens or the secretion becomes excessive. If either of these two contingencies should arise, the ice-compress should at once be substituted by the hot application, these being persisted in for fifteen minutes every two or three hours. The hot water will relieve engorgement of the corneal circulation induced by the intense chemosis of the bulbar conjunctiva, and favor resolution of the cornea.

In the treatment of all forms of conjunctivitis nitrate of silver occupies a leading position, the strength of the solution employed being proportionate to the intensity of the inflammation and the quantity of the secretion. In the early stages, where the discharge is mucoid in character, it should be employed in the strength of from 2 to 4 grains to the ounce, and later, *i.e.*, when the discharge has assumed more of a purulent character, from 10 to 20 grains to the ounce.

It is always best to apply the silver directly by means of a swab, and when the stronger solutions are employed it should always be neutralized by means of sodium chloride. If corneal ulcer occur, atropine should be at once instilled into the eye. Many discontinue the application of the silver as soon as this complication occurs, but if the discharge be very marked and care be taken to apply the silver in the manner just directed, it will usually be found to exercise a most advantageous action upon the course of the disease.

Follicular Conjunctivitis.

Definition.—Follicular conjunctivitis is a form of catarrhal conjunctivitis attended by a great development of the lymph-follicles.

Symptoms.—The inflamed follicles appear as oval, pinkish prominences the size of a pin-head, in the retrotarsal folds, especially the lower. They may be very numerous and may be arranged in parallel rows. In a proportion of the cases they are but few in number, and are scattered over the conjunctiva. There is some photophobia and inability to do near work for any length of time.

Etiology.—Follicular conjunctivitis is frequently seen in epidemic form in schools and asylums, especially where many scholars are massed together, scrofulous subjects being particularly prone to be affected. As there are frequently no subjective symptoms, the physician is

often the first to discover the presence of the follicles.

Pathology.—The follicles consist of a mass of round cells, identical with the lymphoid stroma of the conjunctiva. There is no capsule, and the epithelium is unaffected. In the acute form, when the secretion is abundant, the affection is contagious; but, when there is but little discharge, the follicles lie hidden in the *cul-de-sac* without giving rise to any acute symptoms, and contagiousness is not to be feared.

The disease is one of childhood and adolescence, and may be associated with acute or chronic catarrh, but usually with the latter. The follicles disappear totally after a time; so that the prognosis is favorable, notwithstanding the chronicity of the process and its tendency to relapse, which serves to differentiate the disease from trachoma, with which it bears a close resemblance.

Treatment.—Treatment is the same as for catarrhal conjunctivitis, with the additional indication of bringing about the disappearance of the follicles. This is best accomplished by insufflations of iodoform, aristol, or calomel. In stubborn cases excision or expression of the follicles has been recommended. The hygienic surroundings should be bettered, if need be, the health of the patient attended to, and all near work prohibited. All errors of refraction should be carefully corrected under atropine.

Vernal Conjunctivitis.

Definition.—Vernal conjunctivitis is a chronic catarrhal inflammation of the conjunctiva, usually occurring in children and adolescents, which is attended with the formation of characteristic lesions in the pericorneal and palpebral tissues.

Symptoms.—The changes at the margin of the cornea consist in an accumulation of the conjunctival epithelium with hypertrophy of the underlying connective tissue. This gives rise to large, reddish-gray prominences, which may readily be seen. Although located in the palpebral fissure, these may extend for some little distance into the corneal tissue; or surround the entire cornea. The tarsal conjunctiva is thickened in the neighborhood of the diseased area; its papillæ are enlarged and present a characteristic mammillated appearance. When the lids are first everted, the conjunctiva is covered with a fine, bluish-white haze, which resembles a layer of milk. At the height of the process there is profuse lacrymation, but rarely any discharge. Considerable photophobia is complained of.

The disease usually becomes worse upon the approach of spring, the eyes being comparatively free from irritation in the winter. It is quite rare and generally affects males, being essentially a disease of childhood and adolescence. The prognosis is good, although the disease runs a very chronic course and may persist from ten to twenty years. It finally disappears, however, leaving no trace, except in rare cases, in which a faint haze may remain on the cornea.

Etiology.—The disease frequently occurs in malarial subjects of both sexes, and is at times seen in women with irregular catamenia. The primary cause is unknown.

Treatment.—The disease is incurable, and palliation of the acute symptoms represents all that can be done. Van Milligen, who has had excellent opportunities to study the disease in Constantinople, where it occurs more frequently than elsewhere, has employed a solution of acetic acid, 1 to 20 grains to the ounce, with marked benefit. I have obtained excellent results from the same remedy.

Spring catarrh is an attenuated form of trachoma, the affection of the conjunctiva of the lid being primary and the immediate cause of the hypertrophy of the limbus. Good results obtained from vigorous friction of the lid with mitigated nitrate-of-silver stick. Chibret (Revue Gén. d'Ophtal., Mar., '93).

Literature of '96 and '97.

In vernal conjunctivitis, applications of nitrate of silver or sulphate of copper are not always indicated, and do good only when the stringy, muco-purulent secretion is very abundant. In the pericorneal form the best treatment in massage of the cornea with mercurial ointment, made up with lanolin. Darier (Annals of Ophth., July, '97).

As there is no discharge, the disease is not really a catarrh, and does not demand the same treatment as this class of cases. The eyes should be kept clean with a 10-grain-to-the-ounce solution of boric acid; dark glasses should be prescribed to protect the eyes from the light and other irritants, such as dust, smoke, etc. If there is much pericorneal injection, a weak mydriatic should be prescribed: either atropine in small doses or homatropine. Iced compresses diminish the vascularity and afford marked relief. Arsenic, quinine, and iron should be administered internally.

Extirpation of the hypertrophied papillæ by electrolysis, and obliteration of the superficial vessels supplying the growth in the limbus, have been resorted to with good results.

Purulent Conjunctivitis.

Definition.—Purulent conjunctivitis is an acute, contagious inflammation of the conjunctiva caused by infection with gonorrhœal virus, and attended by a copious, purulent discharge. It is one of the most dangerous and virulent diseases of the eye. The contagion is carried by micro-organisms, the gonococci of Neisser, which appear not only in the pus, but also in the superficial layers of the conjunctiva itself. The gonococci may be found in isolated groups, either in the pus-cells or epithelial cells, and their virulence depends upon the severity of the urethral disease at the time of infection; the more violent the latter, the greater the ocular inflammation.

Purulent conjunctivitis may be produced during any stage of the urethral disease, but about the third week of the existence of the latter is the most dangerous period, the discharge being then very copious, thick, and noxious. The discharge from a gleet may, however, give rise to severe and even destructive gonorrhœal ophthalmia.

According as the affection occurs in adults or infants, it is called *gonorrhœal ophthalmia* or *ophthalmia neonatorum*.

Gonorrhœal Ophthalmia.

Definition.—Purulent or gonorrhœal ophthalmia is a specific purulent inflammation of the conjunctiva characterized by great swelling of the lids and conjunctiva, and by the copious secretion of contagious pus, presenting a marked tendency to destruction of the cornea.

Symptoms.—The period of incubation varies, according to the intensity of the contagion, from a few hours to three days.

Literature of '96 and '97.

In all cases of purulent conjunctivitis the diagnosis should depend upon the bacteriological findings, and not upon the clinical appearance. Diphtheritic conjunctivitis may be present in localized areas without the conjunctiva being infected as a whole. Ulcers of the cornea with exceedingly-rapid necrosis of the corneal tissue may be due to infection with the Klebs-Loeffler bacillus. Antitoxin favorably affects both the conjunctival disease and the corneal necrosis. Myles Standish (Pediatrics, June 1, '97).

At first the signs of a simple catarrhal conjunctivitis may alone be present, but soon the lids become red and so tumefied and tense that the patient is no longer able to open them. The palpebral conjunctiva and retrotarsal folds also become intensely red and swelled, and the former is often speckled with hæmorrhages. The membrane becomes hard and granular, owing to an infiltration of seroplastic lymph into its substance. The bulbar conjunctiva soon becomes similarly swelled, forming a hard rim about the cornea. The discharge is at first watery and sanious, but soon changes to a yellow or greenish-yellow pus. The eye is painful to the touch, and there is intense pain in the eye and temple. The constitutional symptoms are often severe, the patients being generally in a weak and feeble condition. Slight fever is also present in some cases.

This stage—that of infiltration—lasts about three days, when the disease attains its height. The lids then become less tense, the conjunctiva softer, and a copious purulent secretion follows. After a week the discharge gradually declines, the tissues undergo restoration, and, at the end of four to six weeks, beyond a condition of chronic inflammation of the conjunctiva, which persists many weeks, the parts resume their normal appearance. Cicatrices rarely follow.

At times the disease assumes more of a subacute type. All the signs of inflammation are then less severe, the palpebral conjunctiva being alone affected, and it is often only possible to diagnose these cases from catarrh of the conjunctiva by a microscopical examination. When the disease is particularly virulent, it may simulate the croupous type, a false membrane being formed, which gives the conjunctiva a yellowish-gray appearance.

Complications.—The chief danger in purulent conjunctivitis is the implication of the cornea. It results from the pressure of the swelled tissues; the corrosive action of the secretion, including the invasion of the gonococci; and direct continuity of inflammation to the substance of the cornea.

At first the cornea may look dull and slightly clouded; but soon circumscribed areas of grayish infiltration appear, which soon become more dense and yellow, and then form ulcers. The ulceration usually occurs at the limbus, and may lead to rapid perforation. In many instances this is a relatively-favorable result, as further infiltration of the cornea is frequently prevented thereby. In other cases, however, the infiltration may form at the margin of the cornea and extend a considerable distance around its circumference, giving rise to a marginal ring ulcer. Sloughing of a great portion or even the whole of the cornea usually follows, and the eye is usually lost.

The ulceration may also occur at the centre of the cornea, when the whole cornea becomes opaque. As a rule, the greater the severity of the conjunctivitis, the greater the liability to corneal involvement, especially if the bulbar conjunctiva be much chemosed. As a rule, also, the earlier the corneal ulcers form, the more likely are they to result seriously.

> Case of symmetrical corneal ulcers following gonorrhœal ophthalmia in a woman of 22 years. Four weeks after the beginning of an attack, when the discharge had been arrested and an ulcer which had formed in the left eye had healed, a deep, clear, ulcerated surface in each eye suddenly appeared, which extended horizontally across each cornea. Belt (Maryland Med. Jour., July 2, '92).

Corneal ulceration usually appears on about the third day, but this depends upon the severity of the inflammation;

in a certain number of cases it does not appear until late in the disease.

Iritis may supervene when the ulceration has extended to the deeper layers of the cornea or when perforation has occurred. It generally gives rise to great ciliary neuralgia, photophobia, and lacrymation.

The inflammation may extend from the iris to the other ocular tissues, and a panophthalmitis be set up.

Prognosis depends entirely upon the degree of implication of the bulbar conjunctiva, for, if this be much chemosed, corneal ulceration will probably occur and vision be seriously compromised.

Etiology. — Gonorrhœal ophthalmia arises through infection with gonorrhœal pus alone, the virus being conveyed directly from the genitalia to the eyes, or from a diseased eye of another person, or from the patient's fellow-eye by the hand, handkerchief, etc.

All cases of purulent conjunctivitis are of microbic origin, and due to Neisser's gonococcus. All originate from a gonorrhœal focus by devious paths, often, though not always, traceable. Those parts of the conjunctival sac having a cylindrical or a modified cylindrical epithelium—viz.: the palpebral portions and that of the fornices—are the seats of election of the micro-organism. Hinde (Ophth. Rec., Aug., '93).

Case of gonorrhœal conjunctivitis in which the disease occurred in an orbit containing a shrunken ball, over which an artificial eye was being worn. An attack of delirium tremens, probably excited by reflex irritation from the gonorrhœal disease, developed on the second day. Morton (Ophth. Rec., July, '92).

Literature of '96 and '97.

The serious ophthalmias are those produced by streptococci or by an association of streptococci and gonococci, or by the combination of these two with others. The gonococci, when alone, are comparatively harmless (?) and yield to treatment, which should be prompt and vigorous, consisting of copious irrigations with potassium permanganate, boric acid, and cauterization with silver nitrate. This combination acts on all the various species of microbes which may be producing the ophthalmia. Chartres (Arch. Clin. de Bordeaux, Dec., '96).

Case of gonorrhœal conjunctivitis secondary to a gonorrhœa induced by intercourse during menstruation. Formalin proved effective. Hansell (Editorial, Phila. Polyclinic, '97).

There is a direct proportion between ease of transportation and a low rate of blindness, while a higher ratio is to be expected where travel is poor and inconvenient. L. Howe (N. Y. Med. Jour., June 26, '97).

Sequelæ are the result of corneal involvement, for the conjunctiva is usually restored to a healthy condition; but, in the event of the corneal ulceration, all eventualities are possible; from a slight degree of opacity, on the one hand, to adherent leucoma, panophthalmitis, or even atrophy of the globe, on the other.

Treatment.—The chief indication in the treatment consists in carefully and frequently freeing the eyes of the copious secretion; for this purpose bichloride-of-mercury or boric-acid solutions should be employed very often. To do this properly will require the constant care of two intelligent attendants. The patient should be put to bed, and, if but one eye be affected, its fellow should be carefully protected. For this purpose the device of Buller answers admirably. This consists in a watch-glass held in place before the eye by strips of adhesive plaster. It should be removed every forty-eight hours and the eye thoroughly cleansed with a solution of boric acid. The surgeon should warn the patient of the danger of carrying any of the urethral discharge to the eyes and should caution the nurses about exercising the most punctilious cleanliness as regards their

hands, and care in the use of towels, handkerchiefs, etc.

> It is the duty of every physician attending a case of purulent conjunctivitis to warn those living with the patient of the very contagious nature of the discharge from the eyes, and, where possible, to isolate both the patient and the nurse in charge. Johnson (Times and Register, Sept. 16, '93).

Great care should always be exercised in washing the eyes of these cases, as the pus frequently spurts out like a jet when the lids are separated.

If the swelling of the lids prevents ready access to the *cul-de-sac*, canthoplasty should be performed, as this procedure not only gives access to the *cul-de-sacs*, but lessens the pressure of the lids, and gives room for the infection to spread.

In the first stage, ice-compresses should be applied constantly night and day and changed every few moments. In robust subjects or when there is intense initial pain or swelling, marked relief may often be obtained by leeching the temples.

> Irrigations with permanganate of potassium are very effective. The irrigations may be used in infants as well as in adults, and should be performed with the assistance of a blepharostat provided with perforations especially constructed for the purpose. The drug used in the strength of from 1 to 2000 or from 1 to 5000, according to the degree of severity of the disease. The irrigation is but slightly painful, and a purulent discharge is soon converted into a serous one, leaving a slight palpebral œdema, without any characteristic lardaceous thickenings. Terson (Arch. d'Ophtal., Oct., '92).

> In the treatment of fifteen cases of purulent ophthalmia good results were obtained by the mild and antiseptic method (silver, 5 grains; corrosive sublimate, 1 to 5000). Campbell (Harper Hosp. Bull., Detroit, Dec., '93).

In the second stage, when the conjunctiva has become velvety and the discharge purulent, the conjunctiva should be touched with silver nitrate (15 to 20 grains to the ounce of water), to reduce the swelling and the amount of secretion. The silver-nitrate solution should be applied by the surgeon to the conjunctiva of the everted lids and then neutralized with a saturated solution of common salt, as directed in catarrhal conjunctivitis.

> In all cases of gonorrhœal conjunctivitis the gonococcus should be sought for; for, if strong solutions of silver be employed in purulent conjunctivitis which is not gonorrhœal, the liability of the cornea to suppuration is increased. Grandclément (Lyon Méd., Jan. 28, '94).

> Great importance of reaching all parts of the conjunctiva with 3-per-cent. nitrate-of-silver solution in gonorrhœal ophthalmia. Abadie (Bull. Gén. de Thér., Jan. 15, '95).

> When cornea implicated, quinine sulphate, 4 grains to 1 ounce, with smallest possible amount of sulphuric acid; to be used in intervals, but not as a substitute for silver nitrate. Tweedy (Practitioner, Mar., '95).

> Purulent ophthalmia and dacryocystitis successfully treated by potassium-permanganate solutions, 1 per cent. to 10 per cent. Case of diphtheritic conjunctivitis treated by crude petroleum-oil. Vian (Recueil d'Ophtal., Aug., '95).

> Purulent conjunctivitis treated by prolonged subpalpebral irrigations; silver nitrate, potassium permanganate; occasionally mercury cyanide, sublimate. Vacher (Recueil d'Ophtal., June, '95).

It is best to delay the application of silver so long as the conjunctiva is hard and infiltrated and the discharge is watery. A croupous membrane also contra-indicates its use.

In the third stage, when the signs of chronic conjunctivitis appear, the silver should be substituted by crystals of zinc and copper, but these should only be em-

ployed when the cornea is quite free from all signs of acute inflammation and ulceration. During the entire course of the disease, the cornea should be carefully inspected, and, at the first appearance of ulceration, atropine should be instilled. This drug frequently serves a double purpose in combating any existing iritis, as well as the corneal involvement. If corneal ulceration be present, great care must be exercised in making the applications of silver to the everted lids, as pressure on the globe might cause rupture of the ulcer. Care should also be exercised to prevent the silver coming in contact with the infiltrated cornea.

Ophthalmia Neonatorum.

Definition.—This is a purulent inflammation of the conjunctiva occurring in the newborn, characterized by great swelling of the lids and conjunctiva, and the copious discharge of contagious pus.

This is one of the most frequent of eye diseases, and is responsible for more cases of blindness than any other affection, the statistics showing that from 30 to 60 per cent. of the inmates of the different blind-asylums throughout the country owe their infirmity to its ravages. Of the three hundred thousand blind in Europe, thirty thousand were rendered so by ophthalmia neonatorum.

Symptoms.—The disease usually appears on the second or third, more rarely on the fourth or fifth, day after birth. In the latter case, however, it is probable that infection is carried to the eyes after birth, either from the mother or the nurse or some other person suffering from gonorrhœa.

The active symptoms are the same as the gonorrhœal conjunctivitis, except that they are not so severe. The swelling of the lids is not so great and the secretion is less copious. The bulbar chemosis does not attain such a high degree, and corneal complications are not so frequent nor so serious.

The disease may occur in a severe type, with a tendency to invade the cornea; or it may run a milder course, without corneal complication.

> Two cases of abscess of tarsus during decline of ophthalmia neonatorum. Lor (Jour. de Méd., de Chir., et de Pharm., Dec. 15, '94).
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> Study of forty cases of ophthalmia neonatorum, in thirty of which the gonococcus was present and in several of the remaining the Weeks bacillus of acute catarrhal conjunctivitis could be found. Francisco (N. Y. Eye and Ear Infirmary Reports, Jan., '95).
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> In the mild form of conjunctivitis in the newborn there is little pus, much lacrymation, and moderate palpebral injection, although the pneumococcus is present. Parinaud (La Méd. Mod., Jan. 19, '95).
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> Pneumococcic conjunctivitis to be suspected when scarcely reddened palpebral conjunctiva, marked arborescent vascularization of ocular conjunctiva, with slight ecchymosis near corneal border; secretion more lacrymal than catarrhal and containing floating muco-fibrinous flakes. Gasparrini (Annali di Ottalmol., Jan., '95).

The prognosis depends upon the state of the cornea when the case comes under treatment. If this be uninvolved, the chances of recovery are favorable.

> Study of forty cases of ophthalmia neonatorum; average duration of gonorrhœal cases, fifty-three days; average duration of non-gonorrhœal, thirty-six days. Francisco (N. Y. Eye and Ear Infirmary Reports, Jan., '95).

Etiology.—The origin of the contagion is the morbid vaginal secretion, the infection, as a rule, occurring at the time of birth by some of the secretion of the vagina being transferred to the lids of the infant and being carried into the eye the first time that the child's eyes are opened.

Twenty per cent. of all cases of blindness are found in youth, and, of these, 20 to 25 per cent. are caused by blennorrhœa neonatorum. In 85 per cent. of these cases the affection begins within five days after birth, and, if immediately treated, 70 per cent. are cured. Early corneal complications are the gravest. Pflueger (Corres. für Schweizer Aerzte, Sept. 15, '95).

Prophylaxis.—The great aim should be the prevention of contagion during birth. If this be done there is no disease in which prophylactic measures are so efficacious and the results obtained so gratifying. Since the adoption by ophthalmologists of adequate measures, the proportion of cases of ophthalmia neonatorum has been reduced from 7.5 per cent. to 0.5 per cent. Vaginal antiseptics should be employed before labor. Immediately the child is born, the lids should be wiped with a piece of lint saturated in bichloride solution (1 to 8000).

After the child has been washed, during which care should be taken that none of the water is permitted to gain access to the conjunctival sac, a drop of a 2-per-cent. solution of silver nitrate should be dropped into each eye. The solution of silver in this strength excites considerable irritation, and while its application should always be insisted upon in hospitals and the like, in private practice, where no gonorrhœal contagion is suspected, the douche before labor and the cleansing of the lids by bichloride solution, followed by a careful douching of the conjunctival *cul-de-sac* with boric acid will suffice.

In making the applications the child should be laid on its back and its head placed between the knees of the physician, while an assistant seated in front should hold its body in his lap and secure the hands. The lids should then be gently separated by pulling on the skin of the eyelids above the upper and below the lower tarsus, and complete eversion of both lids performed.

Six hundred and sixty-five newborn infants in the Charité treated with a solution of silver nitrate in the strength of 1 to 150, and but one case of ophthalmia neonatorum seen to develop among that number, that being of the membranous variety. This favorable result was materially aided by the most careful attention directed toward the production of asepsis in the maternal genitalia. Budin (Jour. de Méd. de Bordeaux, Oct. 23, '92).

The use of too-strong solutions of nitrate of silver condemned on the ground that they may lead to fatal conjunctival hæmorrhage. Hirst (College and Clin. Rec., Feb., '92).

Silver nitrate at 1 to 150 preferable to avoid conjunctivitis induced by Credé's method. Budin (Jour. de Méd., Feb. 17, '95).

Propensity of newborn infants to rub their eyes with their fists; source of contagion—face and hands, as well as eyes—to be cleansed at birth. Ayers (Amer. Jour. Med. Sci., June, '95).

The substitution of 1-per-cent. solution of bichloride of mercury for the nitrate of silver of Credé's method, as suggested by Mueller, should never be made, as albuminate of mercury so formed produces rapid destruction of the eye. Pflueger (Corres. f. Schweizer Aerzte, Sept. 15, '95).

Literature of '96 and '97.

Report of the committee appointed to inquire whether the methods for the prevention of conjunctivitis of the newborn in hospitals accomplished what was claimed for them by their respective authors. Conclusion that the method recommended for this purpose by Credé, of Leipzig, accomplished all that was claimed for it. It consists in carefully dropping upon the cornea 1 or 2 drops of a 2-per-cent. solution of nitrate of silver. It should be applied in all cases just after or before cleansing the child. W. B. Johnson (Med. Rec., July 11, '96).

Condemnation of the obstetrician who

neglects to adopt Credé's method when there is the least suspicion that the conjunctiva may be infected. A. E. Adams (N. Y. Med. Jour., Apr. 3, '97).

Treatment.—The treatment is the same as has just been given under the gonorrhœal ophthalmia of adults, with the exception that the protection of the sound eye and the application of compresses are not, as a rule, feasible.

Free irrigations twice daily, or oftener in severe cases, with 1 to 500 potassium-permanganate solution recommended. Kalt (Archives d'Ophtal., Dec., '94).

Thorough and frequent irrigations of *cul-de-sacs* with boric-acid solution are very effective. Rohner (Annales d'Oculistique, Dec., '94).

In the early stages frequent irrigation with mercury bichloride (1-3000 to 1-4000) and brushing palpebral conjunctiva with silver nitrate (2 grains to 1 ounce). In the later stages the same remedies, 1 to 1000 and 10 grains to 1 ounce, applied with brush, the surplus being neutralized. Owen (Birmingham Med. Rev., Nov., '94).

Formalin, in 1 to 2000 strength, as a wash, and in 1 to 200 as a collyrium, used with excellent results. Fromaget (Annales d'Oculistique, Feb., '95).

Silver nitrate, at first 1 per cent., then 3 per cent.; bad cases and free, greenish-yellow discharge, mitigated stick; mercuric bichloride irritating to corneal epithelium; potassium permanganate preferable, applied to everted lid by absorbent cotton. Vignes (Memphis Med. Monthly, July 13, '95).

Good results from irrigation with sterilized water. Wilson (College and Clin. Rec., May, '95).

Only silver nitrate, in 3-per-cent. solution thoroughly applied thrice daily, will cure severe cases. Abadie (Le Progrès Méd., Dec. 22, '94).

Free irrigations twice daily, or oftener, in severe cases, with 1 to 5000 potassium-permanganate solution, introduced by means of a hard-rubber tube with a perforated, flange-like expansion, under the lids. Kalt (Archives d'Ophtal., Dec., '94).

Literature of '96 and '97.

Gonorrhœal conjunctivitis in fifty-seven newborn infants treated with calomel. The gonococcus of Neisser was found in the discharge in all the cases. The conjunctival mucous membrane having been syringed with a 2-per-cent. solution of boric acid, and well dried with absorbent cotton, was dusted with calomel. One day after the first application the discharge and swelling of the mucous membrane diminished, even in severe cases. Sometimes the dusting had to be repeated two or three times. The treatment lasted only for a week, and in neglected cases of long standing not more than a fortnight. The results were very satisfactory. Pukalof (Wratch, No. 27, '97).

Granular Conjunctivitis (trachoma, Egyptian ophthalmia, miliary ophthalmia).

Definition.—Granular conjunctivitis is an inflammation of the conjunctiva, characterized by the hypertrophy of the tissues and by the development of small pinkish prominences or granulations on the conjunctiva, the chief tendency of which is to undergo absorption and produce serious cicatricial changes in the lids.

Although it was generally supposed that the disease was introduced into Europe from Egypt by Napoleon's army in 1798, it was subsequently shown that the disease had actually been endemic in Europe several centuries before. Excellent descriptions of the disease were recorded by the ancients, and measures adopted by them for its relief have come to light again in our own day under the form of the operation of scarification. Nevertheless, to Napoleon is due, in large measure, the propagation of the disease, for it was doubtless owed to the frequency with which his armies came in contact with those of other countries, as well as with the civil population, that

the disease spread so rapidly during the first part of the present century.

The Jews, the Irish, the inhabitants of the East, and the North American Indians are especially liable to the affection, while negroes are practically exempt.

Geographically, the disease occurs more often in Arabia and Egypt, while western Europe is more exempt than eastern Europe. In the United States it affects those dwelling in tenement-houses, and is associated with unhygienic surroundings in large cities. It prevails in the Western prairies, and is found scattered widely over the country. High altitudes seem to render a certain immunity to the disease.

> Verification of the law established by Chibret concerning the immunity given by a high altitude. A certain elevation above the sea-level offers the best conditions for cure, but there is no absolute immunity. Sattler (Revue Gén. d'Ophtal., Aug., '90).

> In the City of Mexico trachoma is very rare. The hygienic conditions of the lower classes being of the very worst, it is the altitude of the city (6000 feet) that renders it free from this pernicious disease. Race has nothing to do with the question, as there are many foreigners living in the city who are alike free from any visitation of the inflammation. Chacon (Gaceta Medica de Mexico, June 1, '92).

Symptoms.—There is a great difference in the symptoms, not only on account of the intensity of the changes, but also from the rapidity of the course of the disease. The signs of irritation are greater, the quicker the course of the disease. Usually, the irritation symptoms are only moderate, but slight photophobia, lacrymation, and pain being complained of.

Not seldom the disease is so insidious that the subject does not know of its existence, the disturbance in vision due to corneal complication giving the first indication. This is especially the case when the disease occurs in eleomoscenary acute trachoma. Here the disease begins with marked inflammatory symptoms; the lids are œdematous, the conjunctiva swollen, and there is a rich secretion of pus.

Granular conjunctivitis may occur in either an acute or chronic form, according as it is or is not attended by the signs of acute inflammation.

Acute Granular Conjunctivitis (Papillary Trachoma; Chronic Blennorrhœa).—This is rare in this country and should be differentiated from the violent exacerbations to which the chronic forms of the malady are liable. In this variety there are all the signs of purulent conjunctivitis, with the development of the granulations. The lids swell and the conjunctiva, both bulbar and palpebral, becomes injected. The papillæ are enlarged, and the characteristic granulations are about the size of the head of a pin, and are situated, for the most part, in the retrotarsal folds—chiefly the upper. They are also found scattered throughout the conjunctival membrane.

At first, lacrymation is usually marked, but, later, considerable discharge appears, and superficial ulcers form at the limbus.

After several weeks the disease gradually subsides, usually leaving some cicatrices in the lids to indicate its presence, although in other cases, after the absorption of the granulations, the mucous membrane may be quite smooth.

If the inflammation be but slight and not sufficient to absorb the granulations, the process may run into the chronic form.

Chronic granular conjunctivitis is usually primary, but it may be due at times to the imperfect disappearance of the

acute granulations. The constant factor in this variety of trachoma is the trachoma-follicle, as it exists in all of the different degrees in which these conditions are met with.

The development of chronic granular conjunctivitis is often very insidious. Usually, at first, marked lacrymation is present, although there is but little secretion. If the cornea has become vascular, photophobia may be a most distressing symptom. The lids are swelled, and, upon their eversion, the characteristic granulations spring into view. They resemble sago-like prominences arranged in parallel rows, and are found in the superficial layers of the conjunctiva, especially in the fornix. Rarely a few smaller isolated granules will be seen on the bulbar conjunctiva. At first they are found in the lower *cul-de-sac*, but the upper *cul-de-sac* is soon affected and shows the greatest development of the follicles.

After a few weeks or months the granulations give rise to a more or less active vascular reaction, attended with swelling of the papillæ and a muco-purulent discharge. The papillæ may become so large that they may obscure the granulations. Occasionally the granulations become absorbed, but in the majority of cases fresh eruptions of follicles present themselves during the period of regressive inflammation and go through the same changes as their predecessors.

After a certain duration, grayish lines of fibrous tissue make their appearance, and the final stage of cicatrization begins. As a result of this, dense scar-tissue forms; this exerts traction upon the tarsus—already softened by the pre-existing disease—and produces the deformities of the lids so characteristic of the affection.

Complications.—The corneal complication may take the form of pannus or of ulceration.

Pannus consists in the formation of a vascular tissue of neoformation on the cornea, which begins at the limbus and invades the centre. At the location of the pannus the surface of the cornea is uneven and roughened, and there is a superficial gray and transparent haze, which is infiltrated by numerous vessels; these originate from the blood-vessels of the conjunctiva. The pannus usually begins in the upper part of the cornea and frequently stops below, in a sharp, straight, horizontal border-line. Later, it may develop at other parts of the limbus; so that the entire cornea may become covered. Vision is affected as soon as the pannus reaches the pupil, which, if the cornea be entirely covered, may be reduced to light-perception.

When ulceration occurs, it is either at the edge of the pannus or upon a portion of the cornea which had hitherto been uninvolved. It usually occasions great photophobia and lacrymation.

The hypertrophy of the conjunctiva increases until the diseased process has run its course, when it begins to shrink, and is replaced by cicatricial tissue, with all its attendant evil consequences to the normal contour and function of the lids. The degree of cicatrization depends upon the severity of the early stages of the disease.

The beginning of the scar-formation shows itself in the tarsal conjunctiva, narrow, whitish lines permeating the latter. These lines become more numerous and form a fine net-work, which gradually spreads; the conjunctiva included within the meshes becomes attenuated, until quite smooth and white.

The hypertrophied conjunctiva in the fornix gradually shrinks, becoming shorter, and the folds of the conjunctiva

in that location disappear. This is known as *symblepharon posterior*. In extreme cases the *cul-de-sacs* are reduced to shallow fissures between the lid and the globe. The lids become distorted, through the cicatricial changes in the cornea and tarsus, the latter participating in the inflammation, as well as the conjunctiva. It becomes much hypertrophied, especially along its lower margin, where the conjunctival vessels perforate it. It is especially in this position that the shrinking of the conjunctiva, which follows later, makes itself most felt, and is the main factor in the production of the bow-like distortion of the lids, produced by trachoma. The cilia no longer occupy their normal position, but become displaced, and cause great irritation by being brought in contact with the cornea. This irritation is further augmented if the shrinkage of the tarsus continues, and entropion is produced.

Ectropion, of the lower lid especially, may also be originated, due to the contraction of the orbicularis and exerted upon the lids—already prone to eversion by the swelling of the conjunctiva.

Xerosis of the conjunctiva occurs as a result of the cicatrices. The blood-supply to the conjunctiva is shut off and its epithelium undergoes fatty degeneration. The surface of the membrane then becomes dry and smooth and almost leathery, and the corneal epithelium also becomes thicker and its transparency much interfered with. The eye finally becomes blind and a source of continued annoyance, by reason of the constant sensation of local dryness experienced.

The pannus may clear up entirely, leaving a normal cornea beneath. If there be ulceration, however, opacities remain, which disturb vision according to the extent to which they involve the pupillary area of the cornea. Frequently, as a result of pannus, there occurs a connective-tissue metamorphosis, which greatly interferes with the transparency of the cornea. Another result of pannus sometimes is a bulging, or staphylomatous, condition of the cornea, the tissues of which have become so altered that they give way before the normal intra-ocular tension.

Etiology. — In general, the disease may be said to arise from poor hygienic conditions. It develops in institutions where the inmates are crowded together, in armies, orphan-asylums, almshouses, and the like. It is probable that the so-called lymphatic or scrofulous temperament predispose toward it, although the disease may attack those in perfect health.

Trachoma always arises through infection from another eye already infected, by means of the secretion; only under exceptional circumstances, when the air is heavily charged with the poison, can it be the medium of communication of the disease. The infectious nature of the secretion is doubtless due to micro-organisms; but, while numerous bacteria are found in the secretion, gonococci, streptococci, etc., the specific germ has not yet been isolated.

> Case of infectious conjunctivitis in which one patient lived over a room inhabited by a pork-seller, while in the second the patient was exposed to the fumes arising from a dungheap. The latter case was further complicated by a severe attack of influenza. The disease is doubtless due to animal contagion. The disorder affected the conjunctiva of the upper lid of but one eye in the first case. The ganglia of the parotid gland and those of the cervical region were tumefied. In the second instance the disease took on a more acute form. Here it was attended by the presence of a fungous mass in the deep portion of

the superior *cul-de-sac*. Infiltration of the cornea ensued, which spread and increased in intensity very rapidly. Speville (Annales d'Oculistique, Sept., '93).

Etiological factor in acute contagious conjunctivitis a small, unknown bacillus. Weeks (N. Y. Eye and Ear Infirmary Reports, Jan., '95).

Literature of '96 and '97.

It is always contagious,—frequently epidemic. The symptoms, which vary in severity, begin two or three days after infection, with gluing together of the eyelids on awaking in the morning, and small, yellowish masses at the base of the lashes. There is increased lacrymation, congestion, and turbid discharge. It usually begins first in one eye, but affects both in its course. There are burning pains and the sense of a foreign body; the lids are swelled and discolored; and the eyeball is of a rosy tint, which has given the affection the name of "pink-eye." The symptoms continue to increase for two or three days, and frequently a slight coryza arises. Victor Morax and G. W. Beach (Archives of Ophth., vol. xxv, No. 1, '97).

As the secretion alone causes the infection, therefore, the danger of infection depends upon the strength of the secretion; the richer this is, the greater will the danger be to surrounding persons.

The transfer of secretion from one eye to another is usually accomplished by the fingers or toilet articles which are brought into contact with the eyes, as handkerchiefs, towels, sponges, etc. This is more apt to happen when numbers are crowded together and are likely to use these articles in common.

Pathology.—In trachoma we see an excessive degree of development of the papillæ of the mucous membrane and the formation of the granulations. Microscopically, the granulations may have an imperfect capsule or may have no capsule, but they seem to grow from, or in, the stroma of the conjunctiva. In the acute form the granulations consist of lymph-cells alone. They are to be regarded as new growths in the conjunctiva, and, in addition to the lymphoid cells, the mass of cells and connective tissue is penetrated by blood-vessels. The chronic granulations consist of lymph-cells toward the surface, but their bases are formed chiefly of connective tissue. Gradually the cellular elements are transformed into connective tissue, and in this way cicatricial degeneration of the conjunctiva is brought about at each spot where a granulation was seated.

The development of the papillæ is not characteristic of trachoma, for it is present in moderate degree in every lasting inflammation of the conjunctiva, as in chronic catarrh, vernal and follicular catarrh, and purulent conjunctivitis.

Disposition to the deposit of pigment-particles in the conjunctiva of the Javanese, especially after trachoma. Pigmentation in the epithelial and subepithelial tissue within or without the cells found. Steiner (Schmidt's Jahrbücher, June 15, '93).

Trachoma and follicular conjunctivitis not independent affections; trachomatous state must first pass through follicular state; general treatment necessary. Würdemann (Ophthalmic Rec., Oct., '94).

Trachoma and follicular conjunctivitis two separate affections; epidemics usually of follicular variety. Schmidt-Rimpler (Berliner klin. Woch., Jan. 7, '95).

Literature of '96 and '97.

Study of the normal conjunctiva of rabbits; granulations much resembling trachoma in man found. Lymphatic vessels directly connected with the granulations. Villard (Thèse de Montpellier, '96).

Prognosis.—Acute granular conjunctivitis, or trachoma, is characterized by

its chronicity and by the serious consequences to vision; this, added to its contagiousness, makes it one of the most dreaded of eye diseases. Relapses occur frequently and persistently and may occasion all of the intense inflammatory symptoms of acute granulations. Its great danger lies in its contagiousness and the great rapidity with which it spreads through schools or any institutions where large numbers of inmates are gathered together, by the careless use of towels and common utensils. The prognosis is, therefore, always grave, and demands the adoption of great precautions to prevent a disastrous epidemic.

Treatment.—Prophylaxis is obviously of the greatest importance, and, as the conspicuously-dangerous element is the secretion, cleanliness, adequate air-space, and proper ventilation of the sleeping-rooms must be insisted upon in all crowded institutions. Every patient should be provided with his own basin and towel, or, better still, should be required to wash under "running water." When the disease is once established, rigorous isolation of all those afflicted should be practiced.

The chief aim of the treatment must be to check the development of the hypertrophy of the conjunctiva, and bring about absorption of the granulations in order to prevent the destruction of the mucous membrane, and to reduce the previous results of the disease to a minimum.

In the early stages, frequent washings of the conjunctiva with a 10-grain solution of boric acid and bichloride solutions should be employed; especially is this true of acute granulations. If there be much pain and photophobia and some haze of the cornea, atropine should be instilled in conjunction with the cleansing lotions. A nitrate-of-silver solution should be employed so soon as the discharge becomes marked, in the same manner and to meet the same indications as already described in the treatment of other forms of conjunctivitis.

Literature of '96 and '97.

Free application of 1:5000 to 1:300 potassium permanganate in addition to the usual remedies. Kalt (Arch. d'Ophtal., Aug., '96).

Atropine in granular conjunctivitis may cause the formation of granulations, which cannot be distinguished from true trachoma. J. H. Claiborne (N. Y. Polyclinic, Jan. 15, '97).

The treatment of chronic granular conjunctivitis in the early stages must be non-irritating; but, so soon as the discharge becomes marked, silver nitrate becomes the sovereign remedy. When the acute stage has moderated and the discharge is less marked, the silver salt should be replaced by other caustics: copper, alum, zinc, etc. These drugs must be continued months and perhaps even years, until every trace of hypertrophy has gone and the conjunctiva has become perfectly smooth and clean.

The nitrate-of-silver solution should be applied but once daily, and at times when there are marked signs of irritation, must be wholly withdrawn for a few days, while these are combated with atropine and milder antiseptics.

The prognosis is quite favorable. It should be treated by applications of nitrate of silver of the strength of 1 to 40 or 1 to 50, weaker solutions being less effective. The bacilli found were devoid of movement. Inoculation of a culture on the human conjunctiva produced a typical attack. Victor Morax and G. W. Beach (Arch. of Ophthal., vol. xxv, No. 1).

As it is necessary that the local treatment shall be continued for such a long time during the stage of cicatrization, to

prevent relapses, an ointment of 1 grain of tannin to 1 drachm of vaselin may be ordered and may be applied by the patient himself. Copper may be applied in the same strength.

Pyoktanin has a certain and lasting action in granular conjunctivitis where the inflammatory action is not pronounced. It is necessary to examine the cornea after each application. Its employment is dangerous when the cornea is not intact; that is, when the epithelium is exfoliated, even though the loss of substance is but slight in extent. Trouchaud (Annales de la Polyclinique de Paris, Feb., '93).

Twelve cases of granular conjunctivitis successfully treated by electrolysis; cocaine anæsthesia; each granulation touched with steel needle connected with negative pole; 6 to 7 milliampères; no pain; no scar; lids restored to normal condition; simplicity. Malgat (Recueil d'Ophtal., Feb., '95).

In granular conjunctivitis nothing equal to dusting the lids with tannic acid twice daily. Lal Madhud Mukherji (Lancet, Feb. 9, '95).

Literature of '96 and '97.

Favorable results obtained with the following: Pure iodine, 1 to 2 parts; liquid white vaselin, 100 parts; sulphuric ether, q. s. to make thorough solution. To be applied once daily, taking care to protect the cornea from contact with the solution. Nesnamoff (Centralb. f. prakt. Augenh., Aug., '97).

Application of a 1-per-cent. solution of formalin preceded by an 8-per-cent. cocaine solution highly recommended. If the application is quickly and lightly made, there will be little or no reaction. T. Proskauer (Centralb. f. prakt. Augenh., May, '97).

Numerous surgical procedures have been proposed for the excision of the granulations, and some observers advise the excision of the entire fornix of the conjunctiva. It is probable, however, that the resultant cicatrices cause more mischief than those which would result if the disease were allowed to take its course. This form of treatment has, therefore, met with but little favor from the more conservative clinicians.

A less harmful method, and one which is frequently employed by the ophthalmologists of this country at least, consists in the expression of the granulations by means of forceps. Knapp has devised a roller-forceps especially for this purpose. The reaction following this procedure is at times quite severe; so that it is advisable to employ ice-compresses for some time afterward; to prevent a recurrence of the granulations it is always well to follow the expression by applications of silver nitrate.

The amount of benefit obtained from the expression method is, in general, proportioned to the quantity of exudate in and beneath the conjunctiva; where there had been a considerable amount of exudation, the cure is immediate and apparently permanent. Jackson (Med. and Surg. Reporter, Aug. 20, '92).

(*a*) In the first stage of trachoma the most efficient mode of surgical interference is that of expression, combined with superficial scarification and the introduction of a germicide by the use of a brush. (*b*) In the second stage, where surgical interference is advisable, the treatment known as "grattage" should be combined with expression in some cases. Canthotomy or canthoplasty, if necessary, gives the most satisfactory results. (*c*) The operations, as above advised, convert a contagious into a non-contagious condition, and the patient may be admitted to wards for ordinary surgical cases without fear of infection. Weeks (Jour. Amer. Med. Assoc., Sept. 3, '92).

The procedure of Darier and Abadie used in seventy-five cases; but one grave complication resulting from its use witnessed: a case of total symblepharon due to neglect in the dressing. If a radical cure of the disease could be obtained by this method of treatment, the pain and great local reaction following the operation might be atoned for, but

a single instance of permanent cure was never seen. Trousseau (Archives d'Ophtal., Apr., '93).

Conclusion from the results obtained by the treatment of two hundred cases: Rapid, perfect, and permanent recovery by expression alone, or expression followed by mild caustic treatment, takes place in the majority of cases, especially of the purely follicular type. Imperfect recovery—*i.e.*, disappearance of trachoma, leaving more or less shrinkage of the conjunctiva—results, as a rule, in old neglected cases of inflammatory trachoma. Relapses that are cured by a second or third operation occur in both the simple and inflammatory forms. The operation itself has never injured an eye. Knapp (Archives of Ophthal., Jan., '93).

Knapp's roller-forceps the most expeditious and surest method of treatment, particularly applicable where the fornix and palpebral conjunctiva are covered with large follicles. Gepner (Centralb. f. prakt. Augenheilk., Oct. '92).

Report of 2154 ocular cases in Russia; Knapp's rollers to be used only in connection with silver nitrate or copper sulphate in chronic cases. Walter (Archiv f. prakt. Augenheilk., May, '95).

The greatest emphasis must be laid upon the necessity of placing the subjects under the best hygienic conditions. In the case of patients confined to hospitals, asylums, etc., the utmost pains should be taken to secure good ventilation, nourishing food, and perfect cleanliness, personal as well as general.

When pannus has occurred and the thickening of the conjunctiva subsides, the corneal disease will usually abate *pari passu*; so that the treatment of pannus and of ulcers of the cornea resolves itself into that of the conjunctiva. Atropine should be instilled to combat any existing iritis.

If the pannus is unusually dense and is partly made up of connective tissue, further absorption may be obtained by exciting a violent inflammation of the conjunctiva. An infusion of jequirity is frequently employed for this purpose. This is prepared by steeping the ground jequirity-bean for twenty-four hours in cold water. With this infusion, the conjunctiva of the everted lids is painted thoroughly two or three times daily. A croupo-purulent conjunctivitis is excited and is combated in the same manner as already described under this disease. When the inflammation has run its course, the cornea is frequently found to have regained, in a measure, its former transparency.

Jequirity beneficial in those cases of granular conjunctivitis where there is superficial vascularity of the cornea. Also used the drug with advantage in the fibrous condition which often follows. Emerson (N. Y. Med. Jour., Feb. 11, '93).

Pannus successfully treated with antipyrine. As the insufflations are painful, cocaine should be used at first, and application made daily or every third day, according to the gravity of the case and the effect desired. The violent reaction that follows should be treated by frequently-changed, hot, antiseptic compresses. This method is not applicable to symptomatic pannus, in which the primary condition should be first remedied. Vignes (Recueil d'Ophtal., Aug., '92).

The operations of peritomy, which consists in the destruction of the vessels supplying the pannus, has also been much vaunted for the cure of this condition. After a ring of conjunctival tissue about five millimetres from the margin of the cornea is excised by scissors, the underlying connective tissue is dissected off the sclera, which is then laid bare.

Xerosis admits of palliation only by emollients—such as glycerin, olive-oil, or vaselin—applied freely several times daily.

The distortion of the lids, with the resultant trichiasis and entropion and ectropion which it occasions, only yields to operative measures.

Phlyctenular Conjunctivitis (Lymphatic, or Strumous, Conjunctivitis).

Definition.—Phlyctenular conjunctivitis is a frequent form of inflammation of the conjunctiva characterized by the eruption of one or more grayish elevations or phlyctenulæ on the bulbar conjunctiva. It usually occurs in scrofulous children under ten years of age.

Symptoms.—Children suffering from this disease have the characteristic strumous appearance. They are either pale and thin or bloated and flabby. The cervical lymphatics are enlarged and the nose and upper lip tumefied. There is a moist, eczematous eruption on the face and constant watering of the eyes and nose. Otorrhœa is frequent. A distressing symptom—intense fear of light and blepharospasm, due to the corneal involvement, which occurs in most cases of phlyctenular conjunctivitis — completes a clinical picture which renders an examination of the eyes almost superfluous.

An inspection of the eye, however, will reveal the presence of phlyctenulæ. These appear as minute red eminences, either alone or in numbers. In the latter case they are situated on the limbus of the conjunctiva and resemble grains of fine sand.

In the simple, or solitary, variety the injection of the blood-vessels is localized immediately around each phlyctenule; but in the multiple, or miliary, variety the conjunctival injection is general and is usually quite marked. In the latter variety there is also much photophobia and lacrymation and rarely some discharge. Usually there is an eruption of these phlyctenulæ on the cornea as well. This is always accompanied by an increase in the photophobia and lacrymation and adds greatly to the gravity of the disease.

Etiology.—Phlyctenular conjunctivitis occurs chiefly among the poorer classes, and is fostered by the improper and insufficient nourishment which they receive and by their damp and unhygienic surroundings. It may be found, however, in children, otherwise healthy, whose vitality has been depressed by febrile disturbances, such as measles, whooping-cough, scarlet fever, and the like. The disease rarely occurs in adults, and only when a tendency toward this disease was manifested in youth.

> Examination of the blood in a series of 16 cases of catarrhal and 13 of phlyctenular conjunctivitis. A more or less marked degree of anæmia in 14 of the former and 12 of the latter was found. Howe (Trans. Med. Soc., State of N. Y., Feb., '90).
>
> Conjunctivitis phlyctænulosa is less prevalent in America than in Europe. This is attributable to the better hygienic condition of the lower classes in the former country. Fukala (Archiv f. Augenheilk., Mar., '92).
>
> Emphasis upon the relationship existing between phlyctenular diseases of the cornea and conjunctivitis and general malnutrition. Wallace (University Med. Mag., Apr., '92).

Pathology. — A phlyctenule consists of an accumulation of lymphoid cells packed closely together around a nerve-filament, just beneath the epithelium of the conjunctiva or cornea. Soon after its formation the apex of the mass begins to undergo softening and liquefaction. The epithelial covering is thrown off and a shallow ulcer remains. The softening process continues, the epithelium dips down into the ulcer, and healing is accomplished in ten to fourteen days.

After a time, however, a fresh outbreak of these small grayish nodules occurs; so that the disease may extend over months and at times years, until the

age of puberty is attained, when the eye seems to become protected against further attacks.

In consequence of the corneal involvement, which is usually associated with phlyctenular conjunctivitis, there is always a greater or less degree of cloudiness of that membrane; so that vision is interfered with and the patient rendered incapable of fine work. Again, the scars left upon the cornea are often most unsightly.

Treatment.—This must be directed, in the first place, toward the improvement of the general condition. Notwithstanding the photophobia, open-air exercise should be positively enjoined, as it is absolutely essential for the well-being of the child. All bandages should be removed, the eyes being protected by tinted glasses or a generous shade. The skin should be rendered more active by cold or salt baths, followed by brisk rubbing. The nourishment should be strengthening and administered at regular intervals. No feeding should be permitted between meals; all sweets and pastry should be prohibited, while milk, fresh eggs, red meat (once daily), and proper fruits should represent the bulk of the diet recommended.

Internally, calomel is of value to improve the state of the mucous membrane of the alimentary tract; codliver-oil, syrup of the iodide of iron, syrup of the phosphate of lime, and arsenic may also be administered with advantage.

> If seen in the early stages, it is advisable to avoid all external irritants by the use of smoked glasses. Gorecki (Le Praticien, May 20, '90).

Locally, any existing blepharitis or eczematous eruption about the eye should be combated with white-precipitate ointment (1 to 2 per cent.) and with silver nitrate, after the removal of all crusts with a simple soda solution.

In the simple form, where there is but little irritation, calomel should be dusted into the eye once daily. This drug combines with the tears, and forms a weak solution of bichloride of mercury, which exerts a most beneficial action upon the conjunctiva. Care, however, must be observed that iodine is not being administered internally at the same time with the calomel, for the latter in this event forms with the iodine an iodide of mercury which is very irritating to the eye.

A salve of the yellow oxide of mercury may be substituted for the calomel in many cases with great advantage.

In the miliary variety, or when there is recent corneal involvement with signs of active irritation, these drugs, which are irritating, should not be applied. In these cases the eyes should be kept clean with frequent washings with boric acid, and atropine should be instilled at regular intervals.

The photophobia and blepharospasm usually subside with the improvement in the conjunctival condition. Should it be very distressing, however, much relief may be had by cold baths or from immersions of the child's head in a basin of cold water.

Croupous Conjunctivitis.

Definition. — Croupous conjunctivitis is a catarrhal inflammation of the conjunctiva in which, owing to the intensity of the inflammation, there is formation of a plastic exudate upon the conjunctival surfaces.

Symptoms.—It usually begins with the symptoms of an acute catarrh, but soon attains a severity not witnessed in ordinary catarrh. The lids become œdematous, the conjunctiva much reddened and swelled, especially in the fornix, and a

discharge, at first sero-purulent but later muco-purulent, appears. The tarsal mucous membrane and retrotarsal folds become covered with a grayish-white membrane, the bulbar conjunctiva being but rarely involved. The pseudomembrane can be stripped off, disclosing a raw and perhaps bleeding mucous surface beneath, which serves to distinguish it from the diphtheritic variety.

The pseudomembrane usually disappears after two weeks; the conjunctiva and lids reassume their normal appearance and the signs of an ordinary catarrhal conjunctivitis reappear. There are no resultant cicatrices and vision is but seldom affected, the cornea being only involved when the false membrane spreads to the bulbar conjunctiva, which is of rare occurrence.

Literature of '96 and '97.

Case of recurrent membranous conjunctivitis in which the membrane had been removed several times but always recurred; it had the appearance of a superficial burn. Batten (Ophthalmic Rev., Dec., '97).

Diagnosis.—The main affections from which croupous conjunctivitis are to be differentiated are diphtheritic conjunctivitis and ophthalmia neonatorum.

Diphtheritic Conjunctivitis.—Instead of being limited to the surface of the conjunctiva, the membrane in diphtheritic conjunctivitis involves its deeper layers. The lids are hard and the bulbar conjunctiva is involved, and there is frequent corneal ulceration.

There is no reason not to consider as diphtheritic a case of conjunctivitis presenting false membrane. This form of conjunctivitis can present a more or less grave diphtheritic character, and a relative benignity should not authorize the exclusion of this disease from the diagnosis. In cases of conjunctivitis showing the formation of false membrane the treatment should be most active. The detection of the microbe is the only method of making a sure diagnosis, and the general system may become infected from the local *nidus*. Fernandez (Cronica Médico-quirúrgica de la Habana, No. 11, '92).

Ophthalmia Neonatorum.—In this disease, purulent conjunctivitis, the discharge is much more copious and purulent. Pseudomembranous conjunctivitis is never found among the newborn.

Pathology.—The local inflammation must be regarded as a severe form of catarrh only, in which, owing to the intensity of the inflammatory process, the secretion is richer in fibrin and more prone to coagulation. Various grades of this plastic quality appear. In light cases it may manifest itself as a simple condensation of the secretion, flakes of fibrin forming, which can be readily washed off of the conjunctiva. In some cases, however, the exudate has the tenacity of a true diphtheritic membrane.

Diphtheria bacilli found in a case of croupous conjunctivitis occurring in a child, 5 years old, who failed to exhibit constitutional symptoms. Uthoff (Berliner klin. Woch., Mar. 13, '93).

Croupous conjunctivitis produced in two dogs and two patients inoculated with a pure culture of bacilli that had been taken from a case of the same nature. Kain and Gerke (Wiener med. Woch., Mar. 10, '92).

Literature of '96 and '97.

Behring's serum can be used to differentiate between non-malignant and true diphtheria of the conjunctiva. A. H. Sproneck (Deut. med. Woch., No. 36, '96).

Case of membranous conjunctivitis in which numerous bacilli of Friedländer were found. Cultures were injected into the tail of a mouse, and forty-eight hours later the heart-blood of the mouse was filled with incapsulated Friedländer bacilli. J. Ehre (Lancet, Mar. 20, '97).

Case of chronic membranous conjunctivitis. A boy, 8 years old, had been under observation for eighteen months, with a thick, firmly-attached, yellowish-white membrane covering the conjunctiva of the upper lid. Treatment had exerted but little influence upon the membrane, although it was then becoming thinner. The eyeball had not been seriously damaged. But at one time in its course there had been a severe exacerbation of the disease in the eye, with soreness of the throat and patches of similar membrane on the tonsils, and rise of temperature. Two children that he came in contact with in the same ward at this time developed diphtheria and died. A sister of this boy had presented

Pathology of chronic membranous conjunctivitis. (*Howe.*)

a similar chronic membranous conjunctivitis. After it had lasted nearly a year and a half she developed scarlatina with diphtheritic patches in the throat. This was accompanied by aggravation of the eye-symptoms, and necrosis of the cornea, with loss of useful vision in both eyes.

Although both these cases were carefully studied bacteriologically, and many micro-organisms discovered, the Klebs-Loeffler bacillus was present in each case only during the exacerbation, and not at any other time. (See illustration.) Lucien Howe (Trans. Amer. Ophth. Soc., '97).

Similar case in which bacteriological examinations showed practically pure cultures of diphtheria bacillus from the throat, but none from the eye. The patient recovered from the acute disease, under treatment with antitoxin, but the eye remained unchanged. H. Harlan (Jour. Eye, Ear, and Throat Dis.; Phila. Polyclinic, Dec. 18, '97).

Etiology.—Croupous conjunctivitis is a disease of childhood, and usually develops at first dentition. Its causal factors are the same as those of catarrh, but certain pyrexias, particularly measles and pseudomembranous vulvitis, predispose to it. It may be associated with croup of the larynx, trachea, and bronchial tubes.

Treatment.—Hot-water compresses should be applied night and day until the pseudomembrane is removed. The general health should be seen to, and purgatives administered to produce watery evacuations. All caustics and irritants should be avoided so long as the pseudomembrane is present, but the eye should frequently be washed with bichloride-of-mercury (1 to 5000), boric-acid, chlorate-of-potash, or chloride-of-sodium lotions. As soon as the stage of acute catarrh sets in, the treatment should be the same as in acute conjunctivitis.

Instances of croupous conjunctivitis that was complicated by disease of the entire cornea, an abscess involving the lower half of this latter membrane. The usual treatment failing to arrest the progress of the disease, a dressing of aristol was applied. This was followed in a short time by the most favorable results. Eliasberg (Archives d'Ophtal., Feb., '93).

Irritating remedies, especially silver nitrate, harmful in pseudomembranous conjunctivitis. Valude (Archives d'Ophtal., Oct., '94).

Case of pseudomembranous conjunctivitis in newborn child, due to streptococcus, treated by Roux's serum; total

loss of both corneæ. Darier (Annales d'Oculistique, June, '95).

Diphtheritic Conjunctivitis.

Definition. — Diphtheritic conjunctivitis is an infrequent specific inflammation of the conjunctiva, attended by the formation of a plastic exudate within the layers of the bulbar and tarsal membrane.

Symptoms.—The exudation penetrates deeply into the tissue and causes its death, thereby destroying the nutrition of the cornea and causing subsequent loss of that membrane. The lids become hard, board-like, and tumefied. At first there is a scanty sero-purulent or sanious discharge, which is followed by a more purulent one as the disease progresses. The secretion is very contagious, and, if there be abrasions at the orifices of the mouth and nose, the membrane will quickly invade them. Patches of membrane are often found in the pharynx and nares.

After the period of infiltration—which lasts from one to two weeks—has subsided, the membrane is thrown off, leaving a raw, granulated surface. At times the membrane may be absorbed. After a time vascularization sets in and the symptoms of an ordinary purulent conjunctivitis supervene. The termination of the process, however, is less favorable than in the catarrhal form, for during the period of cicatrization changes occur which cause atrophy and shrinking of the conjunctiva, and not infrequently occasions great deformation of the lids.

Complications. — The chief complication is corneal involvement, which occurs in the vast majority of the cases, and occasions the intense pain by which the disease is accompanied. As a rule, the cornea is affected early in the affection, either by ulceration or diffuse infiltration.

Etiology.—The disease is of specific origin, and the constant presence of Löffler's bacillus has lead to the assumption of this germ being the causal factor in the diphtheritic process.

Children between the ages of two and eight years are usually affected, both eyes being involved. The disease is rare in this country, but is not infrequent abroad, where it occurs in an epidemic form. The prognosis is decidedly grave on account of the tendency toward corneal involvement.

Treatment.—In the first stage, when the lids are hard and board-like, and there is a necessity of limiting the amount of exudation, ice-compresses should be employed, but hot compresses are indicated as soon as the cornea shows signs of involvement. Treatment must be tentative. Mild antiseptic lotions should be employed to remove all secretions, either bichloride of mercury (1 to 8000) or potassium permanganate in 2-per-cent. solution. Silver nitrate is contra-indicated in the early stages, but may be utilized when the membrane comes away. Atropine should be instilled early on account of the tendency to corneal involvement. Great attention should be directed toward building up the general health. Mercury and quinine should be administered and stimulants ordered if the child shows signs of collapse. The isolation of the patients is necessary to prevent further contagion.

Case of diphtheritic conjunctivitis treated with antitoxic serum without much success. Gayet (Archives d'Ophtal., Mar., '95).

Tubercular Disease of the Conjunctiva.

Symptoms.—Tubercular disease of the conjunctiva may be either present itself as a primary or a secondary manifestation; in either event it is an extremely rare disease. In both varieties the dis-

ease occurs in the form of small, yellowish-gray nodules on the palpebral conjunctiva. These break down and form ulcers with uneven and indurated edges. The floors of these ulcers have either a lardaceous appearance or are covered with grayish-red granulations. The conjunctiva is swelled and turgid, the lids are thickened, and there is considerable discharge. The bulbar conjunctiva and the cornea may become affected, and in severe cases the ulcers on the palpebral conjunctiva may burrow down and involve the entire thickness of the lid. Although this gives a clinical picture which is almost characteristic, the diagnosis may be verified by the discovery of the tubercle bacillus in the contents of the ulcers.

> Case of tubercle of the conjunctiva in a boy 15 years of age. The condition resembled that of trachoma; the membrane was greatly shrunken and the eyeball was atrophic. Microscopical study showed giant-cells, but no bacilli. Roberts (Brit. Med. Jour., June 10, '93).

The disease usually affects but one eye and occurs almost without exception in the young. It manifests a great tendency to recur, and may become the starting-point of general tuberculosis.

Etiology.—As a rule, tubercular conjunctivitis is a primary disease and originates in a direct infection of the conjunctiva. When the disease occurs as a secondary manifestation, it is usually transmitted from the nasal or pharyngeal mucous membrane by means of the lacrymal passages.

Treatment.—This should consist in the removal of all the diseased structure if the process be localized, by the curette, knife, or galvano-cautery; but, if the involvement of the ocular structure be disseminated, enucleation should be instantly performed.

Literature of '96 and '97.

> Case of undoubted primary tuberculosis of the palpebral conjunctiva, verified by the finding of a few Koch bacilli. The eye in other respects remained uninvolved. The palpebral ulceration was treated and cured by frequent application of silver nitrate, bathing with saturated solution of potassium chlorate, and curettage. The patient died, two years later, from laryngeal and pulmonary phthisis. H. Armaignac (Ann. d'Oculist., Aug., '97).

Lupus of the Conjunctiva.

Conjunctival ulcers occurring in this disease are distinguishable from tubercular ulcers chiefly by the fact that they have involved the conjunctiva from the skin, instead of from the mucous membrane, and, like cutaneous lupus, they undergo spontaneous healing in one place, while the ulcer keeps advancing in another. The disease occurs either as a primary process or as an extension of the disease from the surrounding skin. It appears as an ulcer, the bottom of which is covered with granulations, which bleed on the slightest touch and are filled with tubercle bacilli.

Treatment consists in thorough removal of the contents of the ulcer with a curette, followed by careful cauterization.

Pemphigus.

Pemphigus of the conjunctiva is a very rare affection, and is usually seen in connection with pemphigus vulgaris of other parts of the body, although it may occur as an independent disease. Bullæ form upon the conjunctiva and are attended with pain, photophobia, and lacrymation. The blisters break down and form cicatrices in the conjunctiva. Repeated recurrence is the rule, so that the membrane finally becomes much shrunken and atrophied, and appears dry, smooth, and tense. The cornea be-

comes cloudy and the lids are frequently distorted, aggravating the symptoms by the displacement of the cilia which this occasions.

Treatment is of no avail, though the condition may be mitigated by emollients, and protection from the light and air by coquilles. Arsenic may be administered internally.

Syphilitic Disease of the Conjunctiva.

Chancres about the eye, as a rule, develop on the edge of the lids; they may also be observed on the palpebral conjunctiva and rarely on that of the globe. The disease is usually transmitted by kissing. At times, however, ulcers may form from the breaking-down of gummata of the conjunctiva.

Instance of a syphilitic ulcer of the bulbar conjunctiva. The initial lesion had occurred eighteen months previously. Under general antisyphilitic measures the local manifestation disappeared promptly. Fromaget (Gaz. Hebd. des Sciences Méd. de Bordeaux, Aug. 6, '93).

Case of mucous patch of the conjunctiva complicated by a pseudomembranous formation in a woman, 20 years of age, who exhibited other secondary lesions of syphilis. The conjunctiva of the lower eyelid was swelled and congested and covered by a pseudomembranous exudate. Schwartzschild (Med. Rec., Apr. 22, '93).

Tumors of the Conjunctiva.

Tumors of the conjunctiva may be both malignant and benign.

Dermoid.—The most common among the latter is the dermoid, which is always congenital and is often found associated with wart-like growths from the skin in front of the ears, and with harelip. They are ascribed to an arrest of development. They occur as pale-yellow rounded or oval bodies the size of a split pea, usually at the extreme limbus of the cornea. Their surface is dry and smooth and frequently has a few hairs projecting from it.

If, as sometimes happens, the growth shows a tendency to involve the cornea or cause irritation, it should be excised, care being taken to avoid injuring the deeper layers of the cornea.

Polyp is a benign pediculated growth of the conjunctiva, which is but rarely seen. It is usually very small and is found in conjunction with the caruncle.

Papillomata are occasionally confounded with polypi, but may be readily distinguished from them by their rough, raspberry-like surface. They may be pediculated or sessile. Both forms of growths may be readily removed with scissors.

Angiomata are rare, but when they occur are usually found in association with a caruncle. They are congenital, but, as they usually increase in size after birth, their removal is usually demanded.

The conjunctiva is rarely the seat of malignant tumors, but both epithelioma and sarcoma may occur. They both arise from the tissue at the limbus.

Epithelioma of the conjunctiva is non-pigmented, and occurs as a flat, reddish tumor with a broad base. The tumor slowly increases in size, involving the cornea like pannus, and is prone to ulceration.

Sarcoma is usually pigmented and may attain large size, the growth being at times very rapid. They rarely attack the cornea.

The early removal of both of these forms of growth is imperative, to prevent implication of the other structures of the eye. Enucleation is frequently demanded.

Cysts.—Simple cysts of the conjunctiva are very uncommon. They appear as translucent spherical bodies the size of a pea, usually on the bulbar conjunctiva, and may be regarded as dilated lymphatic vessels.

Cysticercus. — Subconjunctival cysticercus is also an extremely rare affection. It may be distinguished from the foregoing by the fact that it may be readily moved under the conjunctiva, while simple cyst cannot, as a rule, be moved from its position. The diagnostic point, however, is the presence of a round, white, opaque spot on the anterior surface of the tumor, the *receptaculum* of the cyst. Excision of the growth by dissection is indicated.

Miscellaneous Disorders of the Conjunctiva.

Conjunctival Ecchymosis. — This may be originated by traumatisms or violent inflammation of the conjunctiva, or may occur spontaneously in the aged, from brittle blood-vessels, and in children in association with disease attended by spontaneous hæmorrhage elsewhere, particularly after whooping-cough.

The meshes of the conjunctiva become filled with blood and the staining of the tissues may persist for some weeks. When the ecchymosis appears under the conjunctiva several days after an injury to the head, it becomes an important factor in the diagnosis of fracture of some of the bones composing the orbit.

Chemosis.—Chemosis of the conjunctiva results when the connective-tissue layer is filled with serum, usually as the result of a severe inflammation of the conjunctiva or some of the deeper ocular tissues; it may, however, appear spontaneously.

Lymphangiectasis of the conjunctiva occurs at times as a small collection of blisters on the bulbar conjunctiva, due to distension of the lymph-channels as a result of interference with their circulation. It may occur at any stage and is not significant.

Lithiasis of the conjunctiva consists in the deposit of chalky matter in the ducts of the Meibomian glands, and gives the appearance of numerous, small, yellowish-white spots scattered throughout the conjunctiva. As they frequently occasion considerable irritation, they should be removed by incision.

Amyloid disease of the conjunctiva is due to a peculiar degeneration of the conjunctiva in which pale-yellowish masses appear chiefly on the palpebral conjunctiva, but also in the bulbar portion. The lids become much swelled without the usual attendant signs of inflammation. The conjunctiva resembles white wax.

The disease is primary, although it may also at times be developed from granular conjunctivitis.

Treatment should consist in removing sufficient of the conjunctival masses to permit of greater freedom in the movements of the lids, which are often much restricted, and to gain better vision.

Pinguecula is a small, yellowish elevation in the bulbar conjunctiva near the corneal limbus and usually situated to the inner side. It is composed of connective tissue and elastic fibres, in association with a colloid substance; it is due to the action of external irritants. It has no significance beyond its cosmetic effect, except that it may originate pterygium.

Pterygium.

Symptoms.—Pterygium consists in a triangular fold of hypertrophied conjunctival and subconjunctival tissue of fleshy appearance, generally situated to the inner side of the cornea in the palpebral fissure. It may, however, be on the outer side of the cornea and in the traumatic variety may entirely surround the membrane. The apex of the triangle or the head of the growth is attached to the cornea, while the base spreads out

like a fan into the semilunar fold. The neck of the growth lies between the apex and the base and corresponds to that part which lies on the limbus.

At times the pterygium may push its way across the cornea and disturb vision by involving the pupillary area of that membrane. But usually, however, it shows no tendency to advance into the cornea.

In its early stages the growth is thick and fleshy in appearance; but it becomes paler after a time and its blood-vessels are reduced to fibrous cords, giving the structure a tendinous appearance.

Pseudopterygium may always be diagnosed from the true variety by the fact that a probe may be passed under the neck of the latter, whereas this procedure is impossible in pseudopterygium, owing to the matting together of the tissues by the preceding inflammation.

Etiology.—Pterygium never occurs in children, although it is not an uncommon disease of adult life. Fuchs thinks that its starting-point is usually a pre-existing pinguecula, and that it is due to the prolonged influences to which the conjunctiva in the region of the palpebral fissure is exposed. It is especially common among persons who are submitted to the inclemencies of the weather: sailors, coachmen, farmers, and others.

Pseudopterygium, or traumatic pterygium, occurs as a result of some inflammatory process which causes a lesion of the margin of the cornea. This variety is especially liable to form after burns or marginal ulceration occurring in purulent conjunctivitis or phlyctenular disease.

Treatment.—If the pterygium be small and shows no tendency to involve the cornea, it should be allowed to remain, for its removal for cosmetic purposes will be unsatisfactory, owing to the scar which remains upon the cornea and conjunctiva.

A pterygium may be removed either by excision or by ligature. In the former method the head of the growth is grasped with fixation-forceps and is dissected off from the cornea by a sharp knife. This being accomplished, the growth should be separated from its base by two converging incisions. After the removal of the pterygium, the edge of the wound should be carefully united by sutures. If the growth be very large, it may be split into an upper and lower half after its dissection from the cornea, and the flaps thus obtained transplanted into the superior and inferior *cul-de-sacs*.

Injuries of the Conjunctiva.

Foreign Bodies.—Small-sized foreign bodies frequently make their way into the conjunctival sac and cause considerable pain by the pressure which they exert upon the cornea with every movement of the lid. If the body be found imbedded in the lower *cul-de-sac*, it is an easy matter to remove it, but if it be under the upper lid, it is necessary to evert the latter. This is accomplished by grasping the lashes and the edge of the lid with the thumb and forefinger of the right hand while the patient is directed to remain looking down, slightly pressing upon the upper edge of the tarsus either with a finger of the other hand or some convenient instrument: a blunt pencil, a probe, etc.

Large bodies may remain buried deep in the *cul-de-sacs* for weeks at a time, and merely cause the symptoms of a chronic catarrhal conjunctivitis. Of this nature is the inflammation set up by the "eye-stones" which are frequently introduced into the eye by laymen to remove cinders or other foreign bodies. Having performed their function, they

become imbedded in the folds of the conjunctiva.

Wounds.—The conjunctiva is not infrequently involved in wounds of the globe itself or of its adnexa. If the wound be extensive, the edges should be approximated with stitches, but otherwise a simple boric-acid wash with a protective bandage will suffice.

Burns.—Burns of the conjunctiva are common. These are usually caused by lime, acids, hot water, hot ashes, molten metal, etc., and are particularly serious on account of the subsequent contractions and deformities which they occasion in the lids and damage wrought in the cornea.

If the substance inflicting the burn is lime, the eye should be washed with a diluted or weak solution of a mineral acid, or, if this be not at hand, all particles should be removed at once by forcibly flooding the eye with water from a hose or spigot.

If an acid has caused the burn, it should be neutralized by a weak solution of borax, bicarbonate of soda, or of common salt if nothing else be on hand.

Subsequent inflammation is best combated by cold compresses, boric-acid, atropine, and some emollient substance, such as vaselin.

Wm. Campbell Posey,
Philadelphia.

CONSTIPATION. — Lat., *constipatis* (from *constipare*, to pack together).

Definition.—Prolonged retention of fæces in the alimentary canal; retarded defecation; a symptom resulting from a variety of morbid conditions of the intestines, and not a distinct disease. The strictly-natural law governing intestinal evacuations in man requires one, and sometimes two, discharges every twenty-four hours.

Symptoms.—The symptoms produced by habitual constipation vary much in different cases. Many persons appear to enjoy fair health with an evacuation only once in two or three days. A smaller number continue well with only an evacuation once a week; one woman came under my observation who claimed to have had no fæcal discharge from the bowels for thirty days, and yet had been attending to her household duties all the time, with only a sense of fullness in the abdomen and some dizziness in her head.

Literature of '96 and '97.

Case of Hindoo male, aged 50 years, 5 feet 6 inches high, who has been, since his 30th year, in the habit of passing stools once in six months or so, and even then only two or three hard scybalæ are passed. But every eight months the man gets a severe attack of fever, preceded by rigors, and then he passes, to his entire relief, sometimes consciously and at others in an unconscious state, enormous quantities of black, semisolid, feculent matter, which has evidently been accumulating in his intestines all the while. Notwithstanding all this, the man looks well and healthy. He suffers very little from this except a slight loss of appetite and energy. His abdomen is not bloated, but feels hard on pressure. He does not complain of flatulence; passes urine freely; and sleeps well. S. Kotayya Naidie (Indian Med. Rep., May 1, '96).

In a large majority of persons, however, constipation causes a sense of fullness, lassitude, mental depression, or dull pain in the head, with some impairment of digestion, all of which symptoms are temporarily removed by a free movement of the bowels. In some cases after retention of the intestinal contents from three to five days, a spontaneous diarrhœa supervenes for a single day, after which the constipation returns as before. In many other cases, protracted constipation leads to a violent attack of head-

ache every week or ten days, accompanied by extreme nausea or vomiting for a day, during which the bowels are evacuated, and the next day the patient returns to his ordinary duties, though pale and impaired in strength.

Most of the dyspeptic conditions, dilation of the stomach, etc., are really cases of constipation, and this may mechanically tend to produce hæmorrhoids, hernias, vesico-uterine tumors, hypertrophy of the prostate, etc. Germain Sée (Med. Rec., Feb. 3, '94).

Hysteria in the female and hypochondria in the male, or even conditions bordering on insanity, may be the result of constipation. Staple (Amer. Med.-Surg. Bull., Aug. 15, '94).

In many cases the middle and posterior part of the tongue is covered with a light coat and the urine is deeper color and less in quantity than natural; the appetite is variable. Sometimes the colon is distended with gases, with slight tenderness on pressure and irregular peristaltic movements. In such cases the operation of physic is liable to be accompanied by pains across the abdomen and tenesmus, and some mucus may be evacuated with the fæces. Such symptoms indicate congestion or inflammation in the mucous membrane of the rectum, which is sufficient, in some cases, to cause frequent slimy discharges, while the ascending and transverse colons remain filled with compact fæces.

Many cases of constipation are treated unsatisfactorily with medicine when the real cause is in the rectum. The presence of thickening of the skin and mucous membrane, irritable ulcer or fissure, fistula, or hæmorrhoids frequently interfere with the treatment instituted. W. M. Beach (Pittsburgh Med. Rev., June, '95).

Differential Diagnosis.—Simple retention of the fæcal contents of the intestines longer than natural may be considered as sufficient diagnostic evidence of constipation in an unqualified sense. But as undue retentions of fæces are often caused by a variety of mechanical obstructions, such as strictures, invaginations, concretions, morbid growths or tumors, and visceral displacements, all these have, by common consent, been classed as intestinal obstructions, while the words "costiveness" and "constipation" are properly made applicable only to such cases as depend upon failure of one or more of the physiological conditions on which regular intestinal evacuations depend.

Literature of '96 and '97.

Congenital stricture of the anus or rectum is a frequent cause of constipation, the following being two examples: 1. A child, aged 9 months, always subject to constipation, became obstinately so after being weaned. Rectal examination revealed a membranous septum, with a small central perforation. This embryonic relic had allowed the stools to pass fairly well while suckling continued, but as the fæces became more solid, definite symptoms arose. 2. In a baby, a few weeks old, numerous small motions were found to be associated with anal stenosis due to a fold of mucous membrane which barely allowed a catheter to pass. Congenital rectal stenosis is also said to be due to intra-uterine enteritis, which gives rise to great hypertrophy of the walls of the bowel. Filatow (La Méd. Infantile, Nov. 15, '97).

Rectal examination is often neglected in infants, and thus the cause may be missed. In healthy infants the little finger can be introduced into the rectum; if this is impossible, some morbid condition is present. Marfan (La Méd. Infantile, Oct. 1, '97).

Differential diagnosis involves, first, proof of the absence of mechanical obstructions, and, second, proof that the physiological conditions concerned in natural evacuations are at fault in any given case. In all cases of intestinal

obstruction the pains, distension, and tenderness are uniformly manifested at some one part of the abdomen or pelvis. If the obstruction is from the pressure of tumors or morbid growths these can generally be detected by proper physical examination of the abdomen.

If from stricture or invagination there will be not only well-marked pains and fullness at some one location, but in strictures, especially, the past history of the patients will show them to have been the sequelæ of dysentery, typhoid fever, or some form of primary intestinal ulceration. Obstructions by uterine displacements or rectal concretions are readily detected by direct examinations through the vagina and rectum.

[A result of chronic constipation often seen, which may not only simulate, but also cause uterine trouble, is enlargement and pouching of the lower third of the rectum. This condition is found very frequently in virgins, and gives the pain in the back, discomfort in standing or walking (more particularly in standing), and the sensations of dragging and fullness, as if the parts would fall. This is due to the distension and varicosity of the vaginal and uterine veins, caused by the formation of a proctocele, pressing the vagina forward. Efforts in defecation then cause intense pain, pressing the vagina and rectum downward to the pubis and perineum; instead of relieving the patient, however, the traction on the vagina forces the uterus downward, and prolapsus or retroversion results. In this condition, the correction of the retroversion does not relieve the patient, since the cause is not the retroversion, but the rectocele, due to the constipation. The proper course to pursue is to cure the constipation, when the reposition of the uterus will cure the symptoms. CHARLES B. KELSEY, Assoc. Ed., Annual, '92.]

Constipation not caused by mechaniacl obstruction may result from impairment or suspension of the natural peristaltic motion of the intestines, and from paralysis of the nerves of the rectum concerned in the act of defecation, from irregular contractions of the circular fibres of the muscular coat by which regular peristalsis is prevented, from the reversing influence of continuous nausea, from excessive obesity coupled with loss of tone in the abdominal muscles, and from deficient mucous and glandular secretions, by which the fæces are permitted to become dry and hard. In all these cases a careful manual examination of the abdomen will detect the presence of fæcal accumulations in different parts of the colon and rectum. And their location will vary from day to day, instead of uniformly appearing in the same place, as in cases of obstruction.

Etiology. — Habitual constipation is more frequent in adults than in children, and more frequent in females than in males. Probably the most efficient causes of constipation are sedentary in-door habits with deficient out-door muscular exercise. The first necessarily lessens the efficiency of respiration and internal distribution of oxygen, thereby lessening the tone and activity of the nervous and muscular structures generally; and the omission of the latter still further lessens tissue-metabolism and excretory processes. If we add to the foregoing the depression of the transverse colon and the crowding of the abdominal and pelvic viscera down upon the rectum by well-known female habits of dress, we will have the chief causes why females suffer much more from constipation than the male sex.

The hæmorrhoidal arteries and veins are closely connected with the portal circulation by the anastomosis between the hæmorrhoidal branch of the inferior mesenteric, which supplies the upper part of the rectum, and the hæmorrhoidal branches of the internal iliac, which supply the lower part; congestion of one

circulation means congestion and sluggishness of the other. The rectum, in its descent into the pelvis, goes from the left sacro-iliac synchondrosis to the middle of the sacrum, the ovary and tube on that side being almost in contact with it; a distension of the rectum by fæcal accumulation implies a fixity of the uterus, and a congestion of the pampiniform plexus and congestion of the ovary. To relieve this condition we must not rely on hot douches, iodine, or glycerin applications, but relieve the engorgement of the ovarian veins by the emptying of the rectum. Murray (Archives of Gynecology, June, '91).

Literature of '96 and '97.

There is, beyond doubt, a form of habitual constipation in which there is either diminished irritability of the intestinal nerves or defective development in the muscular coat of the intestine; an hereditary factor is often present. It may be acquired through habit of suppressing the desire, insufficient diet, or abundant diet difficult to digest, deficient in water, or too easily absorbed. Sedentary habits are also a cause, but obstinate habitual constipation may occur even in those who lead an active life. Disturbances in the circulation—as in heart disease, mechanical pressure, and particularly pregnancy—may produce it; but displacement of the bowel, such as occurs in Glénard's disease, is of doubtful influence. Adhesion of coils of intestine together, or to some other organ, is an occasional cause. The relation of constipation to mental disturbance is well known, and the theory of intestinal intoxication, also, cannot be set aside. Prognosis, as a rule, is unfavorable. Ewald (Berl. klin. Woch., Mar., '97).

Another very common cause of constipation is the failure to adopt and persistently maintain a regular time for daily defecation.

Instead, many persons frequently resist a desire to evacuate at the regular time from pressure of other engagements, and thus the nerves of the rectum become habituated to the contact of fæces and cease to renew the desire to evacuate except at long intervals.

Literature of '96-'97-'98.

Constipation generally results from diminished secretion, atonic condition, and relaxation of abdominal muscles dependent on sedentary habits and irregularity in defecation, irrational diet, or excessive use of drugs. Kress (Virg. Med. Semi-Mo., Nov. 26, '97).

Constipation is met with in two forms: (1) general or peristaltic constipation and (2) rectal constipation; both forms may be present. In the second form most cases begin from the neglect of the habit of periodic relief, and the impairment of the evacuant function of the rectum is the primary feature, the rectum becoming no longer merely a passage and an evacuant, but a mere receptacle like the bowel above. The habitual use of aperients is unscientific; the difficulty is in the lowest portion of the canal and is not properly met by stimulants directed to the bowel generally, or to a large part of it. Hingston Fox (Gaillard's Med. Jour., May, '98).

So-called "dilatation of the colon" has been enumerated among the important causes of constipation both in young children and in adults.

Introduction of a large quantity of water into the intestine recommended in order to diagnose a condition of atony or dilatation. One to 1¼ pints are necessary in order to produce the splashing sound in the normal intestine, perceptible in the neighborhood of the transverse and descending colon; while only ⅗ or ⅘ pint will produce the sound if there is atony or dilatation; and in such a case it is perceptible first in the sigmoid flexure, then in the transverse colon, and finally in the entire large intestine. Change of position produces a succussion-sound, and dilatation of the sigmoid flexure may be ascertained, which may be beyond the median line. In the same manner displacement of the transverse colon may be determined, and if simple atony only is present the splashing will be heard in the normal position of the

colon, while if there is also displacement the sound will be heard under the umbilicus. It is indispensable to evacuate the intestine with a purgative before performing this lavage. In catarrh of the intestine the water will return charged with mucus and false membrane, while if the intestine is normal the water will be clear or will contain only some slight epithelial *débris*. Boas (Deutsche med. Zeit., Jan. 15, '95).

More or less distension of the colon is a common symptom resulting from accumulation of gases in nearly all the cases of ordinary constipation.

Atony of the intestine should be separated from chronic constipation, which is often only a symptom of the former condition. The atony usually affects the colon, which is unable to expel the fæces. It may be primary, as the result of improper diet, sedentary habits, or a too frequent use of cathartics; or it may be secondary to many disorders, as obesity, disease of the heart, lungs, or liver, typhoid fever and other intestinal diseases, or organic nervous diseases. It is often found in childhood and may be congenital. The symptoms are marked constipation, headache, vertigo, nausea, and pains in the back and loins. Nervous symptoms are often present. The signs are marked tympany and sometimes the ability to detect the distended colon and fæcal masses by palpation. Friedenwald (Med. News, Aug. 11, '94).

But dilatation as a primary pathological condition causing constipation, without having been preceded by either intestinal paralysis or some form of obstruction, is certainly of rare occurrence; as recently shown by Mr. Frederick Treves, who suggests "that the cases of idiopathic dilatation of the colon in young children are due to congenital defects in the terminal part of the bowel," and consequent obstruction.

Pathology.—The various pathological conditions accompanying constipation have been sufficiently stated in connection with its etiology and diagnosis. Constipation, when permitted to continue several days, may give rise to irritation or inflammation of the mucous membrane in contact with the retained fæces, causing temporary diarrhœa with pain or tenesmus.

Several cases of ulcerated hæmorrhoids, in which medical advice sought not because of the constipation, but because of the pain. They were all illustrations of a vicious pathological circle; for, first, the patients had all become constipated, the constipation led to ulceration, and the ulceration again to constipation. The pain in all was characteristic of ulcer of the lower end of the rectum; for, not only was it very severe at the moment of defecation, but it continued for a considerable time afterward, and was accompanied by intense spasm of the sphincter. Wherever skin and mucous membrane join at the various natural orifices of the body there is a rich nerve-supply and great reflex activity. Hence it is that an ulcer near the anus gives rise to a spasmodic resistance to the outward passage of the contents of the bowel, and so keeps up constipation. Warrington Howard (Lancet, Apr. 28, '88).

In all cases of chronic constipation there is a considerable degree of chronic irritation and subacute inflammation of the cæcum and colon and of the surrounding cellular tissues; this condition not infrequently becomes acute, and is then recognized as an attack of typhlitis. The effect of this subacute inflammation is reflexly to arrest peristalsis. When a purgative is administered in such cases, peristaltic movements are induced, the irritation is increased, and after the evacuation of the bowels, which is rarely complete, the gut becomes more torpid than before. Nevins (Brit. Med. Jour., Dec. 27, '90).

But the more frequent result is the formation of septic materials and their absorption, constituting a degree of auto-infection by which the general feelings of depression, loss of appetite, vertigo,

and paroxysms of sick headache are produced.

Emphasis upon the indolence of the cæcum occurring in children of sufficient age to be left considerably to themselves. They eat in a careless manner, and frequently eat too much. The food remains in the cæcum and large intestine, giving rise to such symptoms as headache, incapacity for study, paleness, and irregular and capricious appetite. Jules Simon (Revue Gén. de Clin. et de Thér. Jour. des Practiciens, June, '95).

Literature of '96 and '97.

Study of the history of three hundred cases, showing that about 60 per cent. of all patients suffer from constipation, the number being proportionately larger among women. While the colon and rectum have not the digestive functions formerly credited to them, their absorptive power is great and the quantity absorbed is in proportion to the time of contact and concentration of the substance. The intestinal system is complex. Since all functional action in the system is reciprocal, it follows that the functional activity of the chylopoietic system must affect the nutrition of the brain and entire nervous system. The absorption of toxic and excrementitious substances produces retrograde changes in the quality of the blood, diminution of the red corpuscles, and, by supplying an infected or imperfect nutriment to the brain, becomes a prominent factor in the production of cerebral anæmia and nervous debility. E. S. Pettyjohn (Med. Rec., May 23, '96).

Prognosis.—When constipation is the result of any form of intestinal obstruction the prospect of permanent relief will depend entirely on the nature and curability of the obstruction itself. But when it depends upon the loss of peristaltic action induced by erroneous habits of life, the prognosis is very favorable, provided the erroneous habits of the patient can be permanently corrected. All such cases can be temporarily relieved by suitable diet, laxatives, and tonic. Relapse, however, will soon follow unless all the primary causes are persistently avoided.

Treatment.—In the treatment of all cases of constipation the use of active cathartics should be avoided as far as possible.

Literature of '96 and '97.

As few purgatives as possible should be used. The methods employed should be: dietetic, physico-mechanical, and medicinal. Such foods should be used as are known to increase peristalsis. Suitable massage is of the greatest value in many cases, but it sometimes fails, and the same may be said of electricity. The usual position taken up in defecation is not the one best adapted for emptying the rectum. In the use of clysters particular attention should be given to the anal parts of the syringe. It should be made of vulcanized caoutchouc, and about 30 to 40 centimetres long. The disadvantage of clysters is that ultimately small quantities of water do not suffice, and then large amounts must be used; the large intestine may thus become overdistended and the injections useless. Regular attempts at defecation with slight pressure should be made. An efficient rhubarb preparation is often very useful, but it may become necessary for the patient to have constant recourse to it. Calomel is especially valuable in children. Castor-oil is not suited for constant use. In some cases, with a certain diagnosis of fæcal tumor, good results are had by combining croton with castor- oil. Large injections of olive-oil may very properly be recommended. Sometimes sedative and antispasmodic remedies are required where constipation is of the spastic type. Ewald (Berl. klin. Woch., Mar., '97).

Purgatives excite increased secretion to soften the fæcal contents, and excessive peristalsis by which the intestine is evacuated, but leave the natural functions of the intestines more exhausted than before. Consequently, while they afford

temporary relief, they never affect a permanent cure. To secure the latter, the actual causes of the constipation must be ascertained and removed.

Sedentary habits must be abandoned; the effects of in-door occupations counteracted by special open-air exercises mornings and evenings, sufficient to secure full oxygenation and decarbonization of the blood; eating freely of fruit, vegetables, and coarse or brown bread; avoiding all use of alcoholic drinks both fermented and distilled, and instead drinking a glass of natural laxative mineral water each morning, and persistently making an effort to evacuate the bowels directly after breakfast each day.

Literature of '96-'97-'98.

Reasonable hydrotherapeutics, cold applications to the abdomen, and cold sitz-baths are often of use; moderate exercise helps, but undue exercise, by the loss of moisture by the skin, often increases the constipation. Rosenheim (Inter. Clinics, vol. iv, '97).

The bitter salines are very valuable, and particularly Apenta water, as it is especially indicated in atony of the bowels, and has the advantage that it does not tend to subsequent constipation. Its action is more gentle than that of other bitter waters, because it contains less calcium sulphate and no magnesium chloride; it is probably owed to these circumstances that it does not cause cramps. Bogoslowsky (Trans. Moscow Soc. for the Preservation of Pub. Health, Nov. 6, '97).

The purgative and alkaline mineral waters are objectionable. In place of them enemata and various disinfectants and drugs intended to strengthen the muscular action of the intestine are employed. Strychnine and resorcin are particularly effective. Boas (Gaz. Heb. de Méd. et de Chir., Jan. 13, '98).

To aid in restoring intestinal peristalsis a pill or capsule may be given each night containing $^1/_3$ grain of extract of nux vomica, and 1 grain, each, of extracts of cascara sagrada and of hyoscyamus. If no evacuation takes place the following morning an enema of warm water may be used soon after breakfast.

Forty-six grains of powdered boric acid to be applied directly to the rectal mucosa. In cases where the mucosa cannot be reached, insufflation of the same quantity of powder should be employed. In from one-half to three hours after the application peristalsis occurs, attended with copious fæcal evacuations. Flatau (Deutsche med. Woch., p. 976, '90).

Caffeine-chloral administered hypodermically is of value; injections of 4 or 5 grains dissolved in water recommended. Ewald (N. Y. Med. Jour., July 22, '93).

Literature of '96 and '97.

A tablet composed of nux vomica extract, podophyllin resin, belladonna extract, and aloin, $^1/_{10}$ grain of each, is excellent for the average cases of long-standing constipation. The tablets should be taken before or after each meal, and, if the effect is too strong, half a tablet, more or less, may be given, never skipping a dose at the regular time. C. E. Boynton (Med. World, Oct., '97).

Beech creasote is one of the best remedies for habitual constipation. Since employing this drug, a single case has not been found where it was not effective or where it was ill borne. It should be administered pure, twice daily after meals, in doses of 1 to 8 drops, beginning with the smaller and increasing until the desired effect is secured; the vehicle is always water, wine and water, or milk. The result is probably due to neutralizing some intestinal toxin which paralyzes the action of the digestive canal. De Holstein (La Semaine Méd.; Lancet, Lond., Oct. 9, '97).

A common source of error is, in many cases, the belief that accumulation of fæcal matter in the large intestine is due to imperfect peristalsis of the bowel, and treatment is directed to it specially, whereas the real need is a modification of the contents of the small intestine.

Pfaff (Boston Med. and Surg. Jour., Sept. 9, '97).

In some cases of special atony of the sigmoid flexure of the colon and rectum aloin or extract of colocynth may be used with advantage instead of the cascara sagrada in the pill. Treated in accordance with the foregoing suggestions, a large majority of the cases of ordinary constipation can be relieved just as long as the patients will faithfully continue correct habits of life.

The troublesome constipation met with in infants can be best overcome generally by giving them fresh air, proper food, and a rectal enema of warm water containing a little chloride of sodium at a stated time each day, without any medicine by the mouth.

It is the duty of the physician to frequently inspect and break up the stools, and sometimes even have them subjected to chemical analysis. In the case of the nursing infant the percentage of fat and the total quantity of breast-milk secreted are the chief factors. Too high a proteid-percentage seems to tend to looseness of the bowels and colic.

The unusual length of the sigmoid flexure in infants favors constipation, and should be relieved by enemata rather than by laxatives given *per orem*. A. Jacobi (Archives of Pediatrics, Jan. to Dec., '88).

Literature of '96-'97-'98.

In artificially-fed infants constipation most commonly arises from the use of a diet which is deficient in fat or proteid or contains an excess of proteid. Children fed on condensed milk are often constipated in spite of the large quantity of cane-sugar in this milk. The reason of this will usually be found to be the low percentage of fat and proteid when the condensed milk is diluted in the usual manner. The remedy may be found in the addition of a teaspoonful of cream for each teaspoonful of condensed milk. Thomas S. Southworth (Phila. Med. Jour., May 21, '98).

In the rare cases in which a fair trial of enemas and suppositories does not succeed a few drops of the elixir of cascara sagrada may be given each evening.

Excellent results have followed the use of both the oil and glycerin enemata in the treatment of constipation.

Large enemata of oil—13½ to 17 ounces—should be given. Either pure olive-oil or poppy- or sesame- oil may be used. Impure oil causes the patient great discomfort. The oil enemas are especially valuable for regulating the bowels of anæmic and undernourished subjects. Fleischer (Med.-Chir. Centralb., Mar. 10, '93).

Literature of '96 and '97.

Obstinate constipation and intestinal diseases may be successfully treated by enemata of oil; after the method of Reiner. Olive-oil is the best, but, as it is rather costly, purified rape-seed oil may be used. The injections are made slowly and carefully, and the patients are told to retain the oil as long as possible, sometimes for several hours. Every day an injection of 1½ to 8 fluidounces of oil is made, with the result that defecation becomes easy, the flatulence diminishes, and in cases where the mucous membrane of the bowel is more seriously affected the ulcers and chronic catarrh improve. Halk (Ugeskrift f. Läger, p. 601, '96).

Regular use of purgatives is to be condemned; instead enemas of warm oil (104° F.), 1 pint for an adult, 2 to 5 ounces for a child, given very slowly, are useful. The patient is placed on his back with the pelvis slightly elevated, the vessel containing the oil stood at an altitude of two feet above the anal opening, and the enema administered by means of a piece of black rubber tubing; the nozzle does not require to be introduced very far, but it must be provided with a large opening at the end, as the viscid oil flows along very slowly. This position should be kept for an hour, to make sure all of the oil has entered the bowel. If after three hours no evacua-

tion results, a warm-water enema may be given. This form of oil enema is a valuable adjunct in very chronic atonic constipation. Rosenheim (Inter. Clinics, vol. iv, '97).

[The method of treatment by glycerin enemata has received thus far only universal commendation. Administered in the form of suppositories it is equally efficient. The only objection to enemata of glycerin offered by patients is the tingling sensation felt in the rectum after the injection, and this can be obviated, without interfering with its action, by adding an equal quantity of water to the glycerin. W. W. JOHNSTON, Assoc. Ed., Annual, '92.]

Massage is gradually affirming its value. In conclusions based upon study of 147 cases, le Marmel showed that (1) mechanical treatment can be classed among those therapeutic agents whose action on the circulation, respiration, and general nutrition is decidedly energetic; (2) that it modifies the abdominal circulation and dispels certain passive congestions, especially those of abdominal plethora; (3) that it increases the muscles in volume and strength; (4) that it is the best curative agent for constipation from muscular paresis or paralysis not due to central nervous disease; (5) that it is the best curative agent for constipation dependent on hypoæsthesia or anæsthesia due to local causes; and (6) finally, that it is formally contra-indicated when the constipation is due to acute inflammation or to tumors.

In children massage removes the cause which is the most frequent; *i.e.*, atony of the muscular coat. It failed in no case in which it was thoroughly tried. It was done usually about 2 P.M., and a stool followed frequently within fifteen or twenty minutes after the manipulation, usually before evening of the same day. Karnitzky (Archiv f. Kinderh., p. 66, '90).

Method of treating constipation followed by good results: The patient is made to lie upon a bench about thirty-two inches wide covered with a hair mattress, and clad in light-flannel underwear, the head supported by means of a pillow, and the knees bent up. The large intestines only, from the cæcum to the rectum, are massaged, as it is usually in that portion of the intestinal canal that fæcal masses are formed and retained. Considerable force is employed, the large intestines being pressed against the ilium by means of the fingers held stiff. J. Schreiber (Wiener med. Presse, B. 36, p. 808, '95).

The following process of massage for constipation is far more efficient than the usual process. The patient is placed on his right side and the operator picks up with his thumb and index of each hand the skin and the subcutaneous tissue at the level of the iliac spine. This makes the intestine directly accessible to the other fingers, and he manipulates it with them, always pressing from above downward, and with the ends of his fingers, for five minutes. Then the patient is turned on his left side and the process is repeated on the cæcum, and the ascending colon, only in the opposite direction, from below upward. This leaves only the small intestine and the transverse colon to be massaged, for which the patient is placed in the decubitus genupectoral position, as this relaxes the abdominal walls and brings the intestines closer into the hand of the operator. Kümmerling (Sem. Méd., Dec. 5, '95).

Literature of '96-'97-'98.

Rolling of a five-pound cannon-ball over the abdomen for five or ten minutes every morning before rising used successfully in a number of cases. Sahli (Annual, '96).

For constipation in infants under 12 months old that cannot be relieved by regulation of diet, massage is recommended. It should be given only in the morning, for not more than ten minutes, and the movements made in a circle about the umbilicus; pressure should be light and exerted especially in the right iliac region. For babies more than a year old the finger-tips are exclusively employed and the movements are con-

fined to the course of the large intestine, from right to left. Carrière (The Practitioner; N. C. Med. Jour., Dec. 5, '97).

To perform abdominal massage the mother anoints her hand with sweet oil or vaselin and slowly and carefully kneads the abdominal walls, grasping the superficial structures and rubbing them upon the underlying ones, following, respectively, the course of the ascending, transverse, and descending colons, and ending with a circular movement of the hand around the umbilicus. J. Madison Taylor (Phila. Polyclinic, May 28, '98).

Electricity and hypnotic suggestion have also been recommended. The first may be classed as an adjuvant to massage of no mean value in cases of intestinal atony, while the third may be considered as meriting as yet but little confidence.

Galvanism has given excellent results, the cathode being used in the rectum and the anode over the colon, upon the abdominal wall. The daily sittings occupy from ten to fifteen minutes and the current-strength used is not enough to cause pain. The daily applications are continued from two to three weeks. Out of 15 cases so treated, 4 were cured, 9 relieved for a time, and 2 not benefited. Leubuscher (Centralb. f. klin. Med., p. 457, '87).

Galvanism and faradism are both efficacious, but the faradic current combined with the static sparks over the liver has proved the more beneficial. One pole of the faradic machine is placed within the rectum, and the other electrode is moved over the course of the colon and held for a short time over the region of the gall-duct. Galvanic applications may, however, sometimes be employed in connection with this form of treatment on alternating days, with great benefit to the patient.

The above was tried in one hundred and fifty successful cases. It is always advisable to look carefully for some remote source of reflex nervous disturbance when a habit of constipation has existed for years without any apparent cause. The correction of such a cause will often materially aid in the recovery. G. B. Dozier (Southern California Practitioner, June, '88).

Greater benefit obtained from the application of the continuous current, with occasional interruptions, than from the application of the faradic current. Twenty-one of forty cases showed greater or less dilatation, as demonstrated by accurate measurement. Stockton (Med. News, Nov. 7, '91).

NATHAN S. DAVIS,
Chicago.

CONTINUED FEVER. See MALARIA.

CONTUSION. See WOUNDS.

CONVALLARIA MAJALIS. — The lily of the valley, a native alike of Europe and North America, has long been held in high repute in Russia, Germany, and Scandinavia as a plant possessed of great therapeutic virtues, rivaling those of purple fox-glove. It is a perennial; has a creeping, much-branched rhizome of about the thickness of a quill; two or three elliptical and smooth radicle leaves; a one-sided racime of light, ten or twelve nodding, bell-shaped, six-lobed, white flowers; very fragant, but of acrid and bitter taste. As found in shops, it appears in cylindrical, wrinkled, whitish pieces marked by circular scars; at the annulate point, eight or ten rootlets. Both the rhizome and the roots are medicinal.

The active principles are two glucosides, denominated, respectively, convallamarin and convallarin: the first a pale-whitish-brown amorphous powder, soluble in both alcohol and water; the second a brownish-white powder soluble in alcohol only.

Preparations and Doses.—Convallaria extract, solid, 5 to 15 grains.

Convallaria extract, fluid, 2 to 20 minims.

Convallaria infusion (10 grains of

flowers to 6 ounces of water), 2 to 8 drachms.

Convallamarin, $^1/_4$ to 2 grains.

Convallarin, 2 to 4 grains.

Physiological Action. — Moderate doses slow and strengthen the heart's contractions; larger doses accelerate the heart and induce irregularity; toxic doses cause progressive paralysis, muscular tremors, complete loss of reflex action, and death when the heart is arrested in systole. Doses that slow the heart heighten arterial tension; it probably also acts directly upon the blood-vessels. Like digitalis, it is a most efficient diuretic when given in the form of an infusion, but is apt to be uncertain in its effects upon the kidneys when exhibited in any other form; it is also emetic and cathartic. While the effect upon the circulation is very like that of fox-glove, it is a more uncertain remedy, and likewise a less powerful one.

Convallamarin reduces the pulse-rate, markedly increases the flow of urine, and is "cumulative" in exactly the same way that digitalis is: *i.e.*, when exhibited in a way that fails to provide for or secure proper elimination; because of this "cumulative" bugbear, it has been suggested that more than one dose during twenty-four hours should not be administered to the same patient; but this precaution is entirely superfluous if the drug is exhibited intelligently and its effects carefully watched. This glucoside, however, is in every way inferior to preparations of the entire drug, and all the latter are inferior to the infusion.

Convallarin is both emetic and purgative.

Therapeutics. — Circulatory Diseases.—Opinions differ greatly as to the value of the drug. By a score of observers it has been extravagantly lauded and by as many more condemned with proportionate severity. It should be remembered, however, that the strength of the different preparations of different manufacturers vary. Again, some employ the petals of the flowers only; some the rhizome; some the root; some the entire plant. Justice demands a standard be set, and the plant studied more carefully from such definite stand-point.

> Convallamarin employed in a number of cases of cardiac affections, finding it of especial service in valvular lesions, with increased venous and diminished arterial tension. Contra-indicated where there is diminished venous and increased arterial tension. Bustamente (El Siglo Medico, Oct. 4, '91).

CONVULSIONS, INFANTILE. See Infantile Convulsions.

COPAIBA. — "Balsam" copaiba, or copaiva, is the common designation of this drug, but is exceedingly inappropriate, since it contains neither of the requisites of a true balsam, viz.: benzoic or cinnamic acid. It is, in fact, an oleo-resin supposed to be derived from *Copaifera Langsdorffii*, but as frequently, perhaps, had from other, but relative, sources, such as *C. officinalis, C. multijuga, C. Guianensis, C. coriacea, C. nitida, C. Martii, C. cordifolia, C. Jussieui, C. Jacquini*, etc., all indigenous to South America or the West Indies and the valleys of the Madeira, Orinoco, and Amazon; the best comes from Belem (Para), as its average of volatile oil is larger, ranging from 60 to 90 per cent., while its most important rival, Maranham copaiba, at most never yields more than 80 per cent. and seldom more than 40, which last equals that of Maracaibo.

Literature of '96 and '97.

> Copaiba collects in ducts, being obtained by making large auger-holes or

boxes (square or wedge-shaped) into the centre of the tree's stem, from which it usually flows at once, giving twelve pounds in three hours; if more should appear, the wound is closed with clay or wax, and reopened in two weeks, whereupon, as a rule, it discharges abundantly. Old trees may furnish two or three flows yearly, and, when abandoned, these ducts, sometimes the length of the stem, occasionally fill, and thus, acting as high liquid columns, furnish sufficient pressure to burst the trunk with a cannon-like report. A tree may yield from 10 to 12 gallons, and its value hinges upon the amount of volatile oil. Culbreth ("Mat. Med. and Phar.," '96).

Para copaiba is pale colored and limpid, Maranham and Rio Janeiro of an olive-oil consistence, and all three form clear mixtures with one-third to one-half their volume of ammonia-water, but milky if more alkali or fixed oil is present. Maracaibo—and all dark copaibas obtain this name commercially—is thick, dark yellow or reddish brown, turbid, and solidifies with magnesia. Besides the volatile oil is contained a resin and bitter principle known as copaivic acid: oxycopaivic acid from the Para form, metacopaivic acid from that dubbed Maracaibo. The odor is peculiar and characteristic; the taste, hot, nauseous, and bitter; is freely soluble in ether, alcohol, fixed and volatile oils, but not at all in water unless it is previously rendered alkaline.

Copaiba-oil is obtained by distillation, and in this the therapeutic virtues of the oleoresin chiefly reside. It is a pale-yellowish liquid; aromatic; bitter, pungent taste and characteristic odor; that from Maracaibo copaiba has a dark-blue tinge.

Unfortunately copaiba is rarely obtained in its purity; that in the shops is usually adulterated with turpentine, gurjun balsam, or castor- or linseed- oils.

Preparations and Doses. — Copaiba (oleoresin), 5 to 15 grains or minims.

Copaiba injection, urethral (copaiba, 10; sodium bicarbonate, 5; tincture of opium, 1; distilled water, to make 768 parts), *ad libitum*.

Copaiba mass (solidified copaiba, 10 to 60 grains) speedily becomes insoluble.

Copaiba mixture (copaiba, 6; liquor potassa, 4; gum-arabic mucilage, 8; spirit of nitrous ether, 24; cinnamon-water, 64), 2 to 5 drachms and more.

Copaiba mixture, Chopart-Wolff's (copaiba, 8; syrup of Tolu, 8; alcohol, 8; spirit of nitrous ether, 1), 2 to 5 drachms.

Copaiba-oil 3 to 15 minims.

It may here be noted the custom of making pills of copaiba by the aid of magnesia carbonate, and by mixing with wax, is pernicious; neither pill-mass is freely soluble, and absorption of the remedy is restricted and in a measure inhibited.

Physiological Action. — Applied locally both the oil and the oleoresin appear to be slightly stimulant. Internally in medicinal doses they stimulate the kidneys to freer action, without, however, materially affecting or modifying the solid constituents of the urine.

The diuretic action is produced by the effect of the drug upon the renal secretory nerves, and not by dilatation of the blood-vessels of the kidney, as believed by Binz. Obelensky (Brit. Med. Jour., Aug. 8, '91).

Copaiba stimulates mucous membrane generally, more especially of the genito-urinary and respiratory tracts; is somewhat feebly astringent, and decidedly antiseptic. Its prolonged use is not unattended with danger and is apt to induce considerable gastro-intestinal irritation, gastric oppression, anorexia, nausea, vomiting, purging, and congestion of the upper air-passages, of the

conjunctiva, irritation of bladder and kidneys, perhaps to the setting up of a nephritis or cystitis, or both. Unpleasant skin eruptions accompanied by inordinate itching and tingling are common sequels to its use; usually these consist of bright-red papules closely resembling the efflorescence of measles, but sometimes scarlatina-like. They begin on the hands, gradually spreading to arms, trunk, and lower extremities.

The drug is very rapidly absorbed into the circulation, and is eliminated chiefly by the kidneys and respiratory tract, and to some extent by the skin.

> The elimination of copaiba by the lungs is insignificant and almost *nil.* Binet (Revue Méd. de la Suisse Rom., July 30, '93).

Binet's conclusions, however, cannot be accepted as final, and are not borne out by evidence.

Copaiba Poisoning.—Copaiba is certainly toxic, though there is no definite evidence of its ever having been a direct cause of death. Indirectly it is accused of giving rise to severe manifestations resembling rheumatic seizures and to renal dropsy. The toxic symptoms are those accruing to large or long-continued doses, greatly exaggerated, along with weakening of arms, of muscles, of face; paralysis; desquamative and pustular eruptions, and, more rarely, tetanoid seizures.

Literature of '96 and '97.

> The drug has a manifest effect upon the skin and is likewise an epithelial irritant; but its action appears to be greatly influenced by individual susceptibility. Assuming that symptomatic dermatitis ensues as part of a general excretory action, the practical conclusion must be that all drugs which produce eruptions should be prescribed with caution lest they injure other organs. Walsh (Med. Press and Circ., No. 3058, '97).

Treatment of Copaiba Poisoning.—The toxic symptoms are rarely such as to require measures other than withdrawal of the drug and the promoting of excretion by all the emunctories. Diuretics and cathartics may be employed, and cannabis Indica or opium used to allay pain.

Therapeutics.—As a whole, copaiba promises little therapeutically that cannot be more palatably and easily obtained through the use of oleoresin of cubeb, oil of turpentine, and other agents of this class. If prescribed, it is best given in capsules, preferably dissolved in some bland oil. It frequently appears in capsular form in conjunction with oil of sandal-wood, or eucalyptus, or cubeb. In mixtures its nauseousness may, in part, be overcome by the use of spirit of chloroform, chloroform-water, and aromatics. The oil is, in every way, a preferable preparation to the oleoresin, being a more constant and definite agent.

Gonorrhœa.—It is in this malady that copaiba has found chief employment, solely because of its antiseptic properties and affinity for mucous tissues; and for all that many practitioners in the management of this malady still rely on this drug, alone or in conjunction with other diuretics or drugs of the same class. It is much overrated, and its real merits are nowise compensatory for the nausea and disagreeable sequels that follow in its train. Again, the uncertainty attending the character of the drug *per se* is such that oleoresin cubeb, which is equally effective, is a more desirable remedy, although perhaps less diuretic, but even in this respect it may be rendered superior to copaiba by the addition of an extremely minute quantity of cantharides. Copaiba is also used as a urethral injection.

Literature of '96 and '97.

Diuretic mixtures:—

℞ Copaiba-resin, 3 drachms.
Alcohol, 5 drachms.
Chloroform, 1 drachm.
Mucilage acacia, 16 drachms.
Water, to make 12 ounces.

M. Sig.: Two to 4 drachms thrice daily. Farquharson ("Guide to Ther. and Mat. Med.," fourth edition, '96).

The following has for many years been in use in Westminster Hospital:—

℞ Copaiba resin, 10 grains.
Dilute alcohol, 15 minims.
Spirit of chloroform, 10 minims.
Syrup of ginger, 40 minims.
Mucilage, 80 minims.
Water, to make 1 ounce.

M. For one or two doses. Murrell ("Manual of Mat. Med. and Ther.," '96).

Leucorrhœa.—The internal administration of copaiba often seems beneficial in the fluxes of females, and also the pudendal eruptions that accrue to or are sequels of these discharges.

Pulmonary Diseases.—These, when attended by excessive secretion, are often benefited by this drug; it is especially available in restraining and modifying bronchial secretion, more particularly in the aged; but it is inadmissible when there is much vascular irritability or fever.

Hepatic Diseases.—In cirrhosis of the liver copaiba, especially when combined with cardiac disorders, has been found of considerable value.

Eight cases, 4 of mitral insufficiency, 1 of aortic regurgitation, and 3 of atrophic cirrhosis, were treated with copaiba, and in all excellent results obtained. The remedy seems to be superior to all other diuretics, especially in cases of dropsy of cardiac and hepatic origin. Oblensky (Brit. Med. Jour., Aug. 8, '91).

The diuretic action of copaiba in hepatic cirrhosis is incontestable, and is energetic when compared to other drugs of this class. Georgiewsky (Le Bull. Méd., No. 44, '92).

In 3 cases of hepatic cirrhosis, 1 of cardiac insufficiency complicated with cirrhosis, 1 of hepatic cancer, and 1 of pleural effusion and apical tuberculosis it was entirely satisfactory as a diuretic. Bronowski (Gaz. lekar., No. 29, '93).

Gonorrhœal Rheumatism.—It has been claimed that this drug is eminently serviceable in the management of gonorrhœal rheumatism, but that it must also be given in very small doses and persisted in for some length of time; also that colchicum may be advantageously connected therewith. But the *rationale* of the foregoing has never been elucidated.

Skin Diseases.—Externally the drug has been recommended in the treatment of chronic skin diseases, notably psoriasis, lepra, lupus, etc., but its value therein is decidedly problematical, except for its antiseptic and stimulating effects. Also it has recently been revised as a dressing for chronic and indolent ulcers, though its value here is no greater than—if as good as—that of many balsamic resins.

G. Archie Stockwell,
(Central Staff).

COPPER.—Copper is a metal that in its pure state appears to exercise little or no effect upon the human economy, but acts as an irritant poison in combination with acids, no matter whether the combination is effected within or without the body. Food cooked in copper utensils that are not kept constantly polished in their interior, by dissolving a portion of the metal, and converting it into salts, proves highly toxic; like transformations occur through the secretions by inhaling or otherwise absorbing fine particles, as,

for instance, in coppersmith's and brassmaker's disease. In medicine its chief value is as a base for the formation of salts. It forms two oxides, red and black, known, respectively, as cuprous and cupric, the latter alone being employed therapeutically.

Preparations and Doses.—Copper acetate, normal, $^1/_8$ to $^1/_2$ grain.

Copper aluminate, mild caustic only.

Copper and ammonium sulphate (ammoniated copper), $^1/_4$ to 3 grains.

Copper arsenate, $^1/_{25}$ to $^1/_8$ grain. See ARSENIC.

Copper arsenite, $^1/_{124}$ to $^1/_2$ grain. See ARSENIC.

Copper benzoate, external use only.

Copper bichromate, caustic only.

Copper bromide, $^1/_{150}$ to $^1/_8$ grain.

Copper carbonate, 1 to 6 grains.

Copper chloride, $^1/_{16}$ to $^1/_8$ grain.

Copper diacetate (subacetate), external use only.

Copper iodide, $^1/_{300}$ to $^1/_{100}$ grain.

Copper nitrate, $^1/_{12}$ to $^1/_6$ grain.

Copper oleate, external only.

Copper oxide (black), $^1/_4$ to 1 $^1/_2$ grains.

Copper penta sulphate, in technical use only.

Copper phosphate, $^1/_8$ to $^1/_2$ grain.

Copper salicylate, external use only.

Cupratin, 1 to 4 grains.

Cuprein. See CINCHONA.

Metallic Copper.—Though pure metallic copper is generally held to be inert *per se*, it is sometimes employed in choleraic maladies, colic, and seizures of like character. The virtues, whatever may exist, most assuredly must arise from the chemical change that takes place within the body; probably a chloride is formed there.

Copper Acetate.—Normal copper acetate is by no means the basic acetate, and the latter finds only technical application. The former, known also as verdegris, and crystallized verdegris, if pure, is obtained in conglomerations of large, dark-green crystals; has a metallic taste and acetous odor; melts at 328° F.; is decomposed by water; soluble in water and alcohol. It requires to be kept well stoppered.

Ammoniated copper, or more properly copper and ammonium sulphate, appears in the form of a dark-blue, crystalline powder, freely soluble in water, and is regarded as an astringent and antispasmodic remedy.

Copper arsenate varies in its form and composition; it should appear as a blue powder, and is freely soluble only in acids; it is little employed, but at one time held high rank as an alterative and antisyphilitic.

Copper arsenite (ortho-arsenite of copper, or Scheele's green) is a pale- or yellowish- green, amorphous powder, soluble in alkaline solutions, slightly soluble in water, and claimed to be antispasmodic and also an intestinal antiseptic. See ARSENIC.

Benzoate of copper is made up of light-blue, crystalline plates or needles, though it is sometimes obtained in powder. It finds no employment at all by way of the stomach.

Copper bichromate is a deliquescent, brown, crystalline salt that requires to be always kept in a closely-stoppered bottle; it is soluble in water and in alcohol, and of but little use at all except for its caustic action.

Bromide of copper, like every other bromine derivative, has been tried in lieu of other bromides, especially in chorea and epilepsy, but was speedily found to be a remedy for evil rather than good, and highly irritating to the stomach. It is a grayish-black, crystalline

powder resembling graphite, but soluble in water.

Copper Carbonate.—There are two forms of copper carbonate, viz.: the blue (sesquicupric carbonate), which is used only as a pigment; and the green carbonate (dicupric carbonate, or artificial carbonate), which is obtained in powdered form and is soluble in acids only. It has been chiefly employed as an antidote in phosphorus poisoning.

Chloride of copper has been employed on a few occasions as a remedy and as a substitute for the sulphate, but it possesses no advantages over the latter, and is even more caustic; it finds its principal use in the laboratory of the chemist.

Nitrate of copper (normal) appears as deep-blue, prismatic, deliquescent crystals, obtained by dissolving the metal in nitric acid, evaporating, and cooling at a temperature not lower than 70° F. It is soluble in water and alcohol, and by the late Dr. Fleming was held to be superior to all other caustics in lupus, malignant ulcerations, and the small excavated semiphagedenic ulcers which occur on the genital organs of both males and females. It is very deliquescent, and can only be applied in a liquid state, the surrounding parts being well protected by oil. It differs from the sulphate in exciting a stronger, healthy or alterative action in the tissues around the ulcer after its destruction. A capital detergent lotion is had by dissolving 2 minims of the liquid nitrate of copper in an ounce of water. It has been administered internally as an antisyphilitic, but without sufficient success to encourage its further use.

Oleate of copper, so called, is really an oleopalmitate, and is best prepared by the double decomposition of a hot solution of cupric sulphate (3 to 8 of water) added to a hot solution of Castile soap (8 to 32) and washing and drying the precipitate. On cooling it forms in solid, dark-green masses that may be subsequently pulverized. It finds chief employment in plasters for warts and corns. An ointment is sometimes made by adding 1 part of cupric oleate to 4 parts of an ointment-base, preferably one made with 2 parts of vaselin and 1 part of paraffin.

Black oxide of copper—there is a red oxide also, but it only finds technical employment—or cupric monoxide, is a brownish-black, amorphous powder that has been employed as a tænicide and resolvent.

Phosphate of copper is a bluish-green powder, at one time heralded as a panacea for tuberculosis.

Copper salicylate appears in the form of bluish-green microscopical needles that are soluble in water, and has found its chief use as an antiseptic application.

Copper sulphate, sometimes termed blue vitriol, occurs as large, deep-blue, efflorescent crystals of strong, metallic, styptic taste. It is soluble in 2.6 parts of water at 59° F., in 0.5° F. of boiling water, and 3.5 parts of glycerin; insoluble in alcohol: decomposed by alkaline carbonates, borax, lead acetate, silver nitrate, mercuric bichloride, calcium chloride, and precipitated by all astringent vegetable infusions. It is mildly escharotic, irritant, and in weak solutions stimulant and astringent; in large doses emetic, but undesirable, and oftentimes dangerous as such, except in cases of phosphorus poisoning, when it proves of special value because of the chemical changes induced.

Copper sulphide, cupric and copper sulphide cuprous, have been employed as external applications in various degrees of dilution, but with no very satisfactory

results: they are of more value to the technical chemist than to the physician.

Cupratin is a copper albuminoid preparation analogous to ferratin.

Copper ointment is had in two forms, one of which is also termed a liniment. Thus, copper ointment proper—which obtains the synonyms of *unguentum æruginis*, Egyptian ointment, and verdigris ointment—is made by incorporating 30 grains of the finely-powdered diacetate ("prepared subacetate") salt with 7 $^1/_2$ drachms of ointment-base, preferably that made with white wax. It is a mild stimulant and escharotic.

The copper liniment, also known as *linimentum æruginis, oxymel cupri subacetas, unguentum Ægyptiacum,* is a stimulant, detergent, and slightly-escharotic preparation, made by dissolving 1 ounce of cupric diacetate in 7 ounces of distilled vinegar, and then adding 14 ounces of honey.

Physiological Action.—All the copper salts are more or less astringent both in substance and solution, the difference for the most part being those of degree; applied to abraded surfaces, they are caustic. Internally they are gastro-intestinal irritants. Though often tonic in minute doses, they are not generally well borne for any length of time, but, like the ingestion of single large doses, provoke nausea, perhaps vomiting, and salivation and purging of blood and mucus. They are also depressant to the nervous system; to the respiratory action, which is likewise accelerated; and to the heart's action, causing a small, weak, rapid pulse. Minute doses augment all the secretions. All are but slowly absorbed and even slower eliminated, this process taking place by way of the *prima viæ*, the salivary glands, the kidneys, and liver, and there is always a tendency to accumulate in the latter organ.

Copper probably acts in some measure as a nervine tonic, but, when given in larger doses, peculiar symptoms set in, not unlike those of lead poisoning, and consisting of headache, neuralgic pains, cramp, and even paralysis. There is no special effect on respiration and circulation. Farquharson ("Therap. and Mat. Med.," '89).

Literature of '96 and '97.

Copper salts probably exist in the blood as albuminates. Some observers have noted a gain in flesh in animals and man after a course of copper, but when persisted in too long the salts give rise to symptoms similar to plumbic poisoning, viz.: constipation, paralysis, etc. Biddle ("Mat. Med. and Therap.," '96).

Internally copper leaves the irritability of the muscles unaffected, but diminishes the total amount of work they are able to do, and also causes powerful contraction of the blood-vessels. Armstrong (Foster's "Prac. Therap.," '96).

People who work in the copper mines are liable to a peculiar greenish coloration of the hair, regardless of its original hue. The beard and moustache are first affected, then the hair of the scalp; and the metal can be demonstrated in the hirsute growth chemically, and under the microscope the color is seen to be uniformly distributed.

It will be observed that the physiological action of copper salts within the economy is largely speculative; they are not employed therapeutically sufficiently often to excite special studies in this direction, though such are greatly to be desired.

Poisoning by Copper Salts.—Here the arsenical copper salts must be excluded, as they partake of the nature of arsenic (see Arsenic). As regards the others, this action is pretty nearly coincident and uniform, and chiefly exaggerations of their effects in large medicinal doses. The symptoms are: vomiting, pain in

bowels, cramps in lower extremities, strong coppery taste in mouth, diarrhœa, convulsions, paralysis, insensibility, and death; marks of inflammation in the stomach and intestines are often noticed at the post-mortem, and, where the case has been protracted, there is often a green tinge of the lining membranes of the *prima viæ* and a jaundiced appearance of the skin.

The symptoms of acute copper poisoning generally come on in about a quarter of an hour after the ingestion of the salt, but may be postponed for one or two hours. There is a very strong taste of copper in the mouth, and often constant expectoration. Excessive salivation and bronchial secretion have been noted. Galippe (Etude Toxicologique sur la Cuivre, '75).

If chronic copper poisoning ever exists among workers of the metal, it must be extremely rare. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Literature of '96 and '97.

Acute poisoning results from the inhalation of copper fumes, eating fruits cooked in copper utensils, or from an overdose of a copper salt. Where inhaled, the first symptoms are those of bronchial catarrh and irritation. Internally administered the symptoms do not usually appear at once; but after an hour's interval there are manifest a strong metallic taste in the mouth, burning and constriction of the pharynx and fauces, salivation and vomiting of greenish matter, and purging, the passages after awhile containing mucus streaked with blood. There are present, also, burning in the epigastrium and griping, colicky pains. A characteristic symptom is a green line on the gums. Sometimes jaundice may be present; and headache, convulsions, suppression of urine, cardiac depression, and hurried respiration are among the more grave symptoms. Butler ("Text-book of Mat. Med., Pharm., and Therap.," '96).

In four cases, all with a previous history of good health, there was a sudden onset of gastric disturbance more or less severe, speedily followed by pains accompanied by dysphagia, cramps, headache, and vertigo. Vomiting terminated the severity of the symptoms. Gentile (La Riforma Med., No. 42, '96).

Case of copper poisoning apparently due to the handling of vines that had been treated on three or four occasions with applications of a solution containing copper. Danet (Le Bull. Méd., '97).

It is only in acute conditions that poisoning by copper salts can occur, and then it is not a question of true poisoning, but of a gastro-intestinal irritation analogous to that which is produced by a common caustic. Very exceptionally are serious symptoms of poisoning observed, as the organism has the greatest tendency to free itself from substances which possess emetic properties. Galippe (Nouv. Remèd., July 8, '97).

Treatment of Copper Poisoning.—Albumin and milk form an insoluble compound with copper salts, provided they are in large excess. They should be preceded by prompt evacuation of the stomach, but the stomach-pump is of little avail when the salt is in coarse particles. Vomiting may be prompted by copious draughts of warm water, etc., and lavage may serve an excellent purpose. Ferrocyanide of iron is also recommended to be given to form an insoluble copper cyanide; the hydrated succinate, the protosulphuret and hydrate oxide, and protosulphuret have also been employed. Opium is usually necessary to allay gastro-intestinal irritation and relieve pain.

Any antidote to be of avail must be given at once and act quickly. Milk and eggs are almost always at hand, and are the most efficacious antidotes. No time should be lost in attempting to separate the yelk from the white of the egg, but the egg should be broken into a bowl as quickly as possible, a little water added, and the whole stirred up and exhibited. The dose should be repeated several times, especially when there is vomiting. Soap or fixed alkali

may be given. The yellow prussiate of potash, when pure, is harmless, and precipitates instantly an insoluble compound of copper from solutions of its salt; when it is to be had in time, it may, therefore, be used as an antidote to the sulphate. H. C. Wood ("Princ. and Prac. of Therap.," '94).

As Emetics.—Copper salts act as emetics without causing much depression of the nervous system, but the sulphate is invariably preferred, since the doses and its cheapness render it more manageable and convenient.

Copper sulphate is more irritating and less prompt as an emetic than the zinc sulphate, and when administered without effect it is best not to repeat it. Stevens ("Manual of Therap.," '94).

To empty the stomach in case of poisoning, make ten powders of a mixture of 30 grains of copper sulphate and 120 grains of white sugar (powdered sugar), and give a powder every ten minutes until vomiting is produced. Roth ("Mod. Mat. Med.," '95).

Therapeutics.—The copper preparations have had a varied and checkered reputation as remedial agents, and have been tried, chiefly on empirical grounds, in a large number of maladies.

Anæmia and Chlorosis.—Formerly they were in repute as "blood-making" agents, and employed in anæmia and chlorosis, and they still retain the confidence of many practitioners, especially where the anæmia is characterized by a bluish color of the skin, the acetate salt having the preference.

Scudder considered the use of coppered pickles as an excellent mode of administering this drug; preferred when there was not great loss of flesh, the skin being waxy, with pallor or greenish tinge of the parts that are normally of a red color. Webster ("Dynam. Therap.," '93).

Literature of '96 and '97.

For chlorosis and functional anæmia, arsenite of copper is given in doses of $^1/_{50}$ to $^1/_{25}$ grain, two or three times daily; but in these conditions hæmoglobinometric examinations have not shown that it is superior to other forms of arsenic. Armstrong (Foster's "Prac. Therap.," vol. i, '96).

Convulsive and Spasmodic Diseases.—More than in any other class of maladies, perhaps, copper has held its own in the management of chorea, epilepsy, hysteria, croup, etc., etc. (see Laryngitis, *post*). In epilepsy especially, the ammoniosulphate has been employed, oftentimes with advantage, in doses of $^1/_2$ grain, in pill form, night and morning, increasing every second day by $^1/_6$ grain. The sulphate in gradually ascending doses has been used in both epilepsy and chorea; it is advised for the former malady to combine it with quinine; it was likewise a favorite remedy of Sir Benjamin Brodie in obstinate hysteria.

Copper has been used in small doses in chorea, epilepsy, etc., but with no marked benefit. Farquharson ("Therap. and Mat. Med.," '89).

The copper salts have nervine-tonic properties and have been given in epilepsy. Whitla ("Pharm., Mat. Med., and Therap.," '91).

In croup, too, the sulphate salt was formerly extensively employed, first to obtain relief by prompt emesis, and next in small doses every fourth- or half-hour for the purpose of checking excessive secretion from the lining membrane of the bronchial tubes and cells. The reports regarding the use of the drug in the past are most favorable.

Literature of '96 and '97.

Copper sulphate is supposed to exert an especial therapeutic action on the larynx; hence it is sometimes given in croup, and for a double reason, therefore, is used when it is necessary to expel any obstructive substances from the glottis by the mechanical efforts

of vomiting. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Genito-Urinary and Venereal Diseases.—By reason of their astringency, copper salts are frequently employed in weak solution for the treatment of gonorrhœa, leucorrhœa, cystitis, etc., and in solution or crystal as topical applications to chancres and other syphilitic sores and internally in lieu of the mercury salts. In gonorrhœa and leucorrhœa, a solution of ammonium sulphate, 15 grains to 2 or 3 ounces of fluid, is occasionally serviceable; again, a solution of the sulphate, 8 to 10 grains to an ounce of solution of subacetate of lead, the whole diluted with 8 ounces of water, is often employed for the former malady; in leucorrhœa, 40 to 60 grains to a pint of tepid water.

For syphilitic ulcerations, the deliquesced copper nitrate is frequently the most suitable application.

> From 2 to 4 grains of subacetate of copper dissolved in an ounce of water is one of the best injections for gonorrhœa; in the latter stage of the disease its effects are particularly good. Goss ("Mat. Med., Pharm., and Spec. Therap.," '89).
>
> In syphilis the sulphate of copper is superior to mercury in its effects on the lymphatic system. The cutaneous secondary manifestations disappear but slowly under its influence, but it prevents the development of mucous plaques and laryngeal accidents; on account of its great activity, it is advisable to interrupt the treatment one or two days in a week. Patients at first have a great appetite; but, if the drug be too-long continued, they suffer from prostration, vertigo, and pallor, with rapid, weak pulse. It is best administered in doses of $^1/_{32}$ grain, in pills or potion as may seem best, three times daily; sulphate of iron may be added if it seems advisable. But even this dose is dangerous when there is syphilitic cachexia, and smaller doses should be given to begin with, gradually increasing to $^1/_{10}$ grain as tolerance becomes established. Price (N. Y. Med. Rec., Nov. 5, '94).

Diseases of Mouth and Throat.—In the sore throat of scarlet fever, a gargle of sulphate of copper, 1 grain to the ounce of water, is sometimes used. The finely-powdered salt, incorporated with honey (10 grains to 1 ounce), is an old remedy for cancrum oris, aphthous ulcerations, and gangrenous affections of the mouth.

Sulphate of copper may be used as a gargle in relaxed sore throat. The aphthæ in aphthous stomatitis are benefited by touching with a copper-sulphate solution.

> The soluble salts of copper combine in the mouth with the liquid albuminous substances of this cavity, and precipitate them more or less completely. The sulphate in solid form may be applied with advantage to the spots of psoriasis, simple or specific, that affect the tongue. Applied in solution along the edges of the gums in ulcerative stomatitis, it generally quickly heals the ulcerated surfaces, though, on the whole, alum is to be preferred. A weak solution painted over the mucous membrane will remove the white, curdy-looking coating of thrush and prevent its renewal. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Ear Affections. — The astringent properties of these salts may render them useful local applications in diseases of the external ear; but, in the main, there are other better and more satisfactory remedies.

Eye Diseases.—It is in this class of maladies that the copper salts have been mostly employed, more particularly the ammoniosulphate, sulphate, and acetate, In opacity of the cornea a solution of the first named (1 grain to the ounce of water or camphor-water) has appeared in some instances to hasten the process of absorption. A collyrium of sulphate of copper

of the same strength has also been found serviceable in the purulent ophthalmia of infants. In granular conjunctivitis the pure salt in crayon form applied to the inner surface of the lids is often most satisfactory.

> Acetate-of-copper solution is a good detergent wash for sore eyelids: from 2 to 4 grains to the ounce of water is a suitable strength; and this also makes a good collyrium for chronic ophthalmia. Goss ("Mat. Med., Pharm., and Spec. Therap.," '89).
>
> In granular conjunctivitis the application of the solid crystal is often very useful for its astringent and stimulating qualities. Stevens ("Manual of Therap.," '94).
>
> Copper sulphate makes a good application in purulent ophthalmia, in the form of "eye-drops," 1 grain to the ounce of water. The solid stick (blue-stone pencil) may be applied to the granulations in the treatment of granular conjunctivitis. Locke ("Mat. Med. and Therap.," '95).

Malarial Fevers.—At one time the ammoniosulphate salt was in some repute as a remedy for intermittent, remittent, and tropical fevers, though on what grounds its administration was recommended is unknown. Copper salts have also been recommended in chronic malarial poisoning.

Sepsis. — Like most metallic substances, copper has been suggested in septic disorders, but latterly its use has become very restricted.

> In threatened puerperal fever good results were obtained by washing out the uterus and vagina with a 5-per-cent. solution of copper sulphate. By control experiments it was found that this salt is antiseptic and fatal to streptococci and staphylococci: the vibriones are, however, not influenced by its use. Tarnier (Centralb. f. Gynäk., May 8, '91; Archives of Gyn., Oct., '91).

Skin Diseases.—Here the value of the copper salts rests chiefly in their power as antiseptics, astringents, antiparasitics, and stimulants. The nitrate is powerfully caustic; hence finds a place in the treatment of lupus and other stubborn maladies. The sulphate is sometimes very efficacious in tinea trycophytina, icthyosis, and ringworm; has also been recommended in scabies, after the scabs are removed. In molluscum the crystal salt has been applied in substance with excellent results; and French practitioners often use a strong solution to remove warts.

> Oleate of copper is generally efficacious to combat ringworm, and is best employed by incorporating with an equal quantity (or perhaps double its weight) of lard. It should be rubbed into the diseased surface thoroughly, and success depends upon the persistence with which the medicament is employed, as much as upon its strength. Joseph Adolphus (Med. Age, Apr. 10, '90).
>
> Twenty-seven cases of ringworm of the scalp treated with copper oleate made into an ointment with vaselin or lanolin, 30 grains to the ounce. The hair was cut as close as possible, the scalp scrubbed once a day, and the unguent applied night and morning; it was soothing and valuable in those cases which had formed kerion. Epilation was not practiced in any case. The average duration of the disease was four months and four days, while it usually lasts in public institutions some six months. Copper oleate is in all respects superior to chrysarobin. Blanc (N. O. Med. and Surg. Jour., Mar. 12, '88).
>
> Oleate of copper may be employed as a plaster for warts and corns. An ointment of copper oleate (1 to 4 or 8 parts of petroleum cerate) is especially useful in ringworm, if lightly rubbed in night and morning, and is recommended for the removal of freckles. Martindale and Westcott ("The Extra Pharm.," Lond., '95).

Tape-worm.—A comparatively-recent application of the copper salts is as a tænifuge.

Black oxide of copper will expel tape-worm when other remedies fail. A good combination is black oxide of copper, 30 grains, and sufficient solid extract of gentian to make a pill mass. Divide into 30 pills, of which give 1 four times daily,—every fourth hour,—at the same time prohibiting acid food and drink during the time the remedy is taken; continue the treatment for a week if necessary. The worm will be expelled completely. Pearson (Med. Stand., Feb., '92).

The following was employed with excellent results for tænia: Black oxide of copper, 3 grains; prepared chalk, 62 grains; alum, 6 1/2 drachms; glycerin, 5 drachms; to make 240 pills; of these 8 to 12 are to be taken daily. The patient takes 2 pills daily for 4 days of the first week, and 4 pills daily for 4 days of the next week, abstaining during this time from acid food and drinks. A large dose of castor-oil is then given, when the tape-worm will be evacuated entire. Segments of the worm are passed during the two weeks of treatment. Schmidt (Wiener med. Presse, No. 5, '94).

TUBERCULOSIS.—In this affection sulphate of copper has been recommended on account of its emetic action. It will be recalled that half a century ago drugs of this class were held to be of value in the early stages of phthisis.

Phosphate of copper is of great value in tuberculosis, but it must be in a nascent state and soluble in an alkaline medium. It may be given by making pills as follows: Acetate of copper, 2 grains; crystallized phosphate of soda, 12 grains; with powdered licorice and glycerin sufficient to make mass. Dose, 1 pill, repeated as often as seems advisable. Lutton (Le Praticien, Jan. 16, '88).

Literature of '96 and '97.

In incipient tuberculosis copper phosphate is claimed to act as a specific and dynamic agent. It may be given twice daily in pill form by adding to a suitable mass 1 grain of crystallized sodium phosphate and 1/6 grain neutral acetate of copper; or they may be given in mucilage of gum arabic; or 1/6 grain of phosphate of copper dissolved in 10 minims of glycerin may be injected subcutaneously. Bull recommends the sulphate in phthisis. Armstrong (Foster's "Prac. Therap.," vol. i, '96).

In the diarrhœa of phthisis sulphate of copper is often prescribed, but the dose should not exceed 1/4 grain, and it is best administered as a pill made with an equal weight of opium. Murrell ("Manual of Mat. Med. and Therap.," '96).

ULCERATIONS.—As a wash to weak, indolent, ill-conditioned, or irritable ulcers, small, excavated, semiphagedenic, and specific, non-specific and malignant, the copper salts are valuable. The liquor cupri ammoniosulphas of the old London Pharmacopœia (1 drachm to the pint of distilled water) is an excellent preparation, as is also the Egyptian liniment (see *ante*), and a solution varying in strength according to individual demand of 1 to 10 grains of sulphate to the ounce of water. The nitrate salt is used for chancres and phagedenic ulcers in a pure state, and the sulphate is sometimes applied in powder or in solid crystal.

A powder of copper sulphate dusted over sluggish sores destroys unhealthy granulations and is a powerful local stimulant. This salt is much appreciated in veterinary practice. A lotion made of the strength of 3 grains of the salt to an ounce of water may be applied to chancres or ulcers. The nitrate, owing to its deliquescent properties, soon becomes, on slight exposure to the air, a styptic, caustic fluid, which has yielded good results when applied to syphilitic ulcerations, on the tongue, in the mouth and throat, and on the genitals. It differs from the sulphate in exciting a stronger, more healthy, and alterative action in the tissues around the ulcer after the destruction of the latter. An excellent detergent lotion is had by adding 2 minims of the liquid copper nitrate to an ounce of water.

Whitla ("Pharm., Mat. Med., and Therap.," '91).

Copper sulphate makes a good application to indolent ulcers. It removes dead tissue, and by its stimulant effect promotes healthy granulations. Locke ("Mat. Med. and Therap.," '95).

DIARRHŒA AND DYSENTERY. — In chronic dysentery and diarrhœa a combination of copper sulphate and opium is often serviceable: $^1/_4$ to $^1/_2$ grain of former and $^1/_2$ grain of the latter, given thrice daily; but it occasionally induces severe griping in spite of the opiate; in such case 2 or 3 grains of monobromated camphor constitute a valuable addition. The drug is, perhaps, most serviceable in the diarrhœa of phthisis, though some of the older authors speak highly of it in the chronic diarrhœa of infants.

Copper sulphate is a good astringent in advanced and obstinate diarrhœa. It may be prescribed as follows: Copper sulphate and powdered opium, of each, $^1/_2$ grain; extract of gentian, 3 grains; for one pill, constituting a single dose. Farquharson ("Therap. and Mat. Med.," '89).

Injected into the rectum in the strength of 5 to 20 grains to the ounce of fluid, copper sulphate will be found of service in those cases of diarrhœa which arise in the lower bowel and are dependent on ulceration. It is also sometimes given in pill form by the mouth in doses of from $^1/_4$ to 1 grain. Hare ("Pract. Therap.," '94).

UTERINE DISORDERS.—Copper sulphate is in considerable repute among some gynæcologists, particularly on the continent of Europe. It is especially employed in the treatment of catarrhal disorders.

Copper sulphate employed in 10 cases of endometritis, 7 of which were blennorrhagic in character, and 1 each puerperal, post-puerperal, and catarrhal. In all the remedy was applied locally in the form of pencils, and the results were highly satisfactory. This salt acts superficially, and does not produce the deep scars caused by zinc chloride; its effects, though less powerful, are more certain than those of the latter drug, and it does not produce atresia of the uterine canal. Annaud (Bull. Gén. de Thér., May 15, '92).

POISONING.—The emetic properties of the copper salts, more particularly the sulphate, sometimes render them of value in cases of poisoning. (See also EMETIC, *ante*.)

In 5- to 10-grain doses copper sulphate is a speedy emetic, acting like zinc sulphate in formidable poisoning cases. Whitla ("Pharm., Mat. Med., and Therap.," '92).

It is said sulphate of copper should never be given as an emetic except in phosphorus poisoning, when it acts as a chemical antidote. Even here its use must be most cautious, for Thornton has proved that an antidotal dose given to a dog poisoned with phosphorus may produce death before the latter agent can do so. Hare ("Prac. Therap.," '94).

As an emetic in phosphorus poisoning, sulphate of copper should always be chosen. H. C. Wood ("Princ. and Prac. of Therap.," '94).

The sulphate salt is the chemical antidote in phosphorus poisoning, yet it should be given with great caution lest of itself it produce poisoning. It is a speedy emetic, since it acts directly upon the stomach; but if emesis is not induced at once, sulphate of zinc or mustard should be employed. Butler ("Textbook of Mat. Med., Therap., and Pharm.," '96).

NERVOUS DISORDERS.—It is generally believed that copper acts in some measure as a nervine tonic; hence it has been employed in neuralgias, particularly the trigeminal variety, in cerebrospinal meningitis (see CONVULSIVE MALADIES), paralyses attendant upon structural changes in the spinal cord, such as sclerosis and locomotor ataxy, etc., and nervous cough; but in all these the ad-

vantages claimed to have been reaped are, to say the least, doubtful.

G. Archie Stockwell,
(Central Staff).

CORN. See Foot.

CORNEA, DISORDERS OF THE (see also Keratitis).—Most injuries of the cornea are of importance chiefly on account of the accompanying injury of deeper structures, such as the iris and crystalline lens, or because of the lodgment of foreign bodies, or through infection giving rise to keratitis, or more extended inflammation of the eye.

Burns. — Injuries frequently cause corneal ulcer (see below). Ultimately it may lead to corneal opacity or irregular astigmatism (see Astigmatism). The same is true of burns, either by heat, acids, or caustics. A burn by heat or by nitric acid may cause a superficial coagulation of the corneal tissue, giving an impression of complete opacity of the membrane, but upon the separation of the injured tissue, which may occur in a few hours or at most a few days, the cornea is found to be clear and comparatively uninjured. Burns by lime are frequent, and very serious in their effects, the lime forming a union with the tissue, which makes it difficult to remove, and continuing, therefore, to act as a caustic for a considerable length of time.

Treatment.—Simple burns by steam or hot metal after removal of the metal should be treated by keeping the eyes closed under a light bandage and cleansing twice a day with boric-acid solution.

Injury by quicklime may be met by the filling of the eye with olive-oil; and especially requires the earliest possible removal of all the retained caustic. Other caustic alkalies may be neutralized by very dilute acids, as vinegar and water; but reliance should be mainly placed on washing with water or solution of boric acid.

Acids may be neutralized by lime-water, or solutions of sodium or potassium bicarbonate, or soap-suds. But the best means is by free washing of the conjunctiva with a 1-per-cent. solution of sodium bichlorate.

Foreign bodies are so frequently imbedded in the cornea because the cornea occupies nearly two-thirds of the space between the opened eyelids, and a much larger proportion of that space when the eyes are partly closed, as they are when the entrance of a foreign body is anticipated. Again, the tissue of the cornea is of such consistence as to retain such particles as may penetrate it, whereas the conjunctiva and subconjunctival tissue are so loose that foreign bodies imbedded in them easily work out.

When a foreign body is imbedded in the cornea it commonly causes irritation and suppurative inflammation, by which it becomes loosened and easily drops out, or is wiped away by the lids. If, however, it lie at the bottom of a considerable loss of substance it may lie there for some time, although quite detached from the corneal tissue. Under these circumstances it becomes a source of irritation, causing chronic weakness of the eye, photophobia, and excessive lacrymation, and the development of vessels in the adjoining part of the pericorneal space, which push out to the seat of the foreign body, giving an appearance of a chronic phlyctenular ulcer or superficial vascular keratitis.

> Case of keratitis bullosa, in which there were two cilia in the anterior chamber, one of which had penetrated Descemet's membrane; seems to lend support to Brugger's belief of permeation of fluid into the corneal parenchyma. The accompanying cuts give a very good

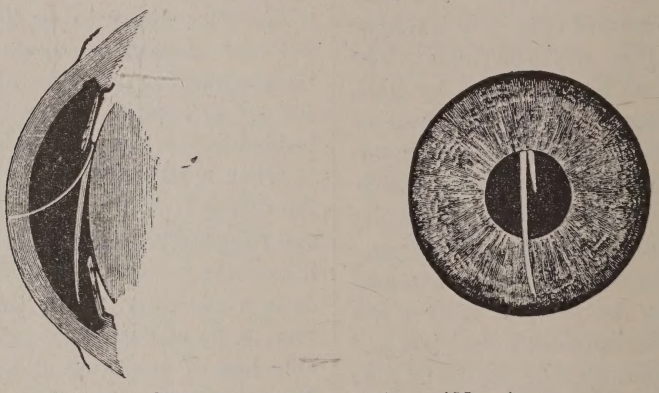
idea of the relative positions of the cilia. Meyer (Centralb. f. prak. Augenheilk., Jan., '89).

Literature of '96-'97-'98.

Among 200 cases of foreign body in the cornea 180 presented themselves for its removal within 1 week, 11 in the second week, 7 in the third week, and but 2 after more than 3 weeks. Ten cases are reported of foreign bodies retained in the cornea from 3 weeks to 18 months, and a few instances referred to in literature in which they have been retained even longer. Edward Jackson (Brit. Med. Jour., Jan. 8, '98).

Diagnosis.—The search for a foreign body in the cornea should be made by all the following methods: Oblique illumination, the ophthalmoscope, and with the eye placed so as to reflect from its surface an area of light, as before a large window. If the foreign body has been imbedded many hours or days there also will be pericorneal redness, most decided at the part of the corneal margin nearest the foreign body. In using oblique illumination foreign bodies of light color are rendered evident when the light is strongly concentrated on the cornea and the iris in comparative shadow. Dark particles are rendered distinct by concentrating the light on the iris behind, thus furnishing a light background. Light foreign bodies are best seen against the black pupil; dark ones against the illuminated iris. It is therefore necessary to vary the oblique illumination and to look at the cornea from different directions.

With the ophthalmoscope all foreign bodies except particles of glass appear black against the red reflex from the pupil. By turning the eye in different directions, this reflex must be obtained through different parts of the cornea. Sometimes with the ophthalmoscope the appearance of a foreign body is caused by a slight disturbance of the corneal surface; so, that after the position of such a black speck has been ascertained it must be examined by oblique illumination.



Cilia in the anterior chamber. (*Meyer.*)

The reflection of an area of light, as a large window opening to the sky, or a strongly-illuminated card held close before the eye, is uniform from the normal cornea. But when by the presence of a foreign body the corneal surface is roughened, the irregularity caused in the reflection is very noticeable, and furnishes the most-readily-applicable method of recognizing the presence and location of such an injury or foreign body. If, how-

ever, the disturbance of the surface be slight, it is liable to be masked by the layer of mucus which covers the normal cornea; and to avoid this source of error the corneal surface should be dried by touching it with a bit of absorbent cotton.

Treatment.—In general, foreign bodies lodged in the cornea should be at once removed. This is usually a very simple operation with the eye placed under the influence of local anæsthesia. A single drop of a 2-per-cent. solution of cocaine, or a 1-per-cent. solution of holocain, placed directly upon the cornea produces the necessary anæsthesia in from three to five minutes. Occasionally a foreign body can be wiped away by a little absorbent cotton wrapped closely and firmly around the end of a probe or match-stick. If more firmly imbedded the ordinary spud is to be used by thrusting it into the wound alongside of the foreign body, and by something of a wedge-like action, pushing the foreign body out.

Foreign bodies of a certain character, as splinters of wood or the beards of grain or grasses, may require to be extracted as a splinter is extracted from the skin, by making an incision along it with a needle or cornea-knife, so as to freely expose it, and then lifting it out of its bed. When the foreign body extends somewhat into the anterior chamber, the eye should be kept quiet until the aqueous humor has refilled the chamber. Then a broad needle is to be thrust underneath the foreign body, and held with its point imbedded in the posterior surface of the cornea, while the foreign body is extracted.

Occasionally when the condition of the patient, or the lack of proper instruments, or of a local anæsthesia renders the extraction of the foreign body impossible, it is proper to cleanse the surface of the eye as thoroughly as possible, and allow it to remain for a few days until the process of suppuration has loosened it. Then it can be washed or wiped out. But such a process is always attended with danger of infection of the deeper structures of the eye and serious damage or complete functional loss of the organ.

Bits of iron imbedded in the cornea very quickly give rise to a brown stain, probably due to oxide of iron. This stain may remain after the removal of the foreign body, but is always cast off within a few days. It is better to remove it at once by scraping, as it often proves a source of irritation and always ultimately separates as a slough.

> Study the effects of the deposit of rust in the cornea by placing particles of iron in the corners of cuts. Five minutes were sufficient to make the iron reaction appreciable, metallic iron being chemically irritant, while iron oxide was not. The ring of rust found about the foreign body consisted of hydrated oxide of iron, and was chemically innocuous. The corneal epithelium showed itself to resist extraordinarily the invasion of the oxide of iron. Gruber (Archiv f. Ophth. [Gräfe], B. 11, H. 2, '94).

Powder-grains imbedded in the cornea at first cause much irritation and inflammation. But if this has passed away the remaining stain, consisting of minute particles of carbon, may be retained indefinitely, without being a source of further trouble or danger.

Literature of '96 and '97.

> Such powder-grains are best removed by the galvano-cautery, the tip being heated to a white heat and touched to each grain sufficiently long to destroy it with the tissue in which it is imbedded. Edward Jackson (Albany Medical Annals, May, '97).

Cornea, Opacities of.

The bulk of the cornea, being a highly-specialized tissue closely related to ordinary connective tissue like that composing the sclera, is liable by slight degeneration to lose its transparency. All considerable injuries or losses of substance of the cornea are repaired by cicatricial connective tissue, which usually fails to become entirely transparent. Hence, corneal opacities are a probable sequel of all other diseases or injuries of the cornea. Slight haziness of the cornea is spoken of as *nebula*. A more dense localized haziness, amounting to almost complete opacity is called a *macula*. More dense and complete opacity, from its usual color, white, is called *leucoma*. The density of the opacity indicates the severity of the lesion causing it and the age of the patient, recovery from the severe lesions being more complete in early life.

Varieties.—The opacity usually occurring with age as a gray arc slightly within the upper and lower margins of the cornea is the *arcus senilis*. It extends in some persons to form a complete ring, *annulus senilis*, separated by a zone of comparatively-clear cornea from the sclera. Sometimes it occurs in early life; and even in early childhood.

Congenital opacity of the cornea is rare. It may arise from intra-uterine inflammation, or from an arrest of the clearing of the cornea, which is originally opaque. This clearing beginning at the corneal margin, such opacities usually involve the centre. They may diminish in early childhood, although this is unusual; and occasionally somewhat similar opacities are said to occur after birth and to increase.

Case of congenital central opacities of both corneæ in a 3- or 4-day-old child. There were no inflammatory symptoms, and the child was apparently otherwise healthy. The mother suffered from supposed malaria in the six months of pregnancy, for which large doses of calomel were administered; to this the author attributes the condition. Boyle (Jour. of Ophth., Otol., and Laryn., July, '89).

Two cases of symmetrically-placed opacities of the cornea, occurring in mother and son. The boy was 8 years of age, and presented in each cornea (as shown in lower portion of figure) a central macula surrounded by a ring of superficial pin-point opacities. These had been observed for a long time, but one year previously had enlarged, following an attack of malarial fever. Laveran's corpuscles could not be detected and there was no evidence of congenital syphilis. Examination of the mother's eyes showed similar opacities in each cornea, which had been present as long as she could remember. These are shown in the upper portion of the figure. Oliver (Amer. Jour. of Ophth., Aug., '92).

Literature of '96-'97-'98.

Record of an instance where the first, second, and fourth children of a family were blind from congenital opacity of the cornea, most dense at the centre. There was a deep anterior chamber and rather large eyeballs. The third child had normal eyes. The mother was healthy, the father when 20 years old had suffered from inflammation of both eyes, lasting eight months; and leaving a central clouding of the cornea. Wernicke (Ann. d'Oculistique, Oct., '96).

Microscopical examination of the corneæ of an infant suffering from congenital opacity, dying on the third day, and without other congenital anomalies. The chief lesions were found in the posterior layers of the cornea and were allied to those of interstitial keratitis. A. Telpljäschin (Archives of Ophthal., Jan., '97).

A boy, 8 years old, who had also been seen at two years of age, presented opacity of the left cornea, most dense above and to the nasal side of the centre. Through the clearest portion the outline of the pupil could be dimly observed. The opacity was located in the

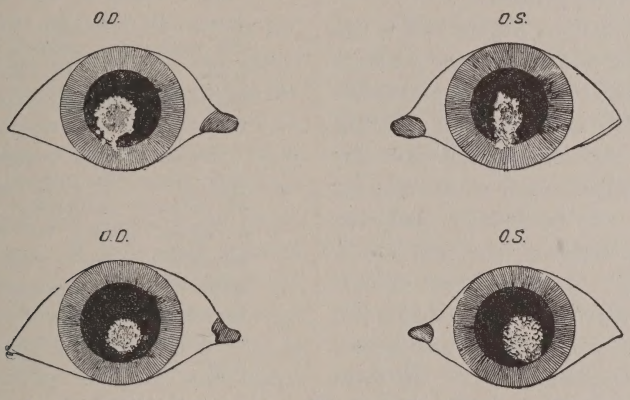
superficial and middle layers. It had not materially changed in the six years. The right eye had a transparent cornea, but was myopic and amblyopic. H. Moulton (Jour. of the Amer. Med. Assoc., Jan. 29, '98).

Opacities due to inflammation of the cornea are most dense immediately after the subsidence of the inflammation, from which time they diminish with greater or less rapidity according to the age of the patient and the nature of the opacity. Sometimes quite a noticeable macula will be left by an inflammation occurring a few weeks previously that has been quite overlooked or forgotten. The general clouding of the cornea from interstitial keratitis clears first from the margin, and, usually in the course of several months, or one or two years, is reduced to a nebula, although perfect recovery is rare.

Peculiar greenish discoloration of the cornea following traumatism, thought to be related to corneal hæmorrhage and attributed to the presence of hæmatic pigment. Regarded as one of the accidents partly dependent upon hæmorrhage into the anterior chamber and neighboring tissues, especially into the corneo-scleral junction in front of Descemet's membrane and around the canal of Schlemm. Vossius (Archiv f. Ophth. [Gräfe], vol. xxxv, No. 2, '89).

Study of two cases of staining of the cornea by blood-pigment. In the first case the central part of the cornea was stained a brownish color, leaving a narrow, clear, and colorless rim at the periphery. Intra-ocular tension equaled —1, and there was no light-perception. After enucleation the discoloration of the cornea was seen to extend throughout the whole thickness. The anterior chamber was filled with blood-clots, the lens was opaque and calcareous, and the vitreous was shrunk. There was complete detachment of the retina, and projecting from its outer surface were two transparent cysts. Examination with the microscope showed that, disseminated throughout the discolored portion of the cornea, there were numerous small, refracting granules, mostly of an oval or circular form. In the second case in the centre of each cornea there was an irregular-shaped patch of a rusty-brown color, surrounded by a zone of bright red. There can be no doubt but that the pigment was derived from the blood, having found that in all the cases reported there was blood in the anterior chamber. Treacher Collins (Transac. Ophth. Soc. of United Kingdom, vol. ii, '91).

Opacities connected with anterior syn-



Symmetrically-placed opacities of the cornea. The upper figures represent the appearances presented by the eyes of the mother, the lower those of the son. The pupils are represented as dilated, in order to give the configuration of the opacities against a dark background as clearly as possible. (*Oliver.*)

echia remain dense throughout life. Vascular opacities connected with granular or phlyctenular conjunctivitis are capable of great improvement after the cure of the conjunctival diseases that cause them. Those due to granular conjunctivitis, or trachoma, commonly involve the upper half of the cornea, the part in contact with the roughened upper lid, and sometimes encroach slightly on the lower lid. Those due to phlyctenular keratitis take the form of a fasciculus of vessels running out from one or more parts of the corneal margin.

Anterior, or *corneal, staphyloma* is the bulging opacity which follows perforation of the cornea, either by traumatism or by ulcerative inflammation, leading to prolapse of the iris and union of the iris and new-formed tissue in the corneal scar. It does not necessarily ensue in all cases of prolapse of the iris into a corneal opening. After cataract extraction very extensive prolapse of the iris may occur, and yet, without any active treatment, the prolapse will in time entirely flatten down, leaving a slight opacity with adhesion of the iris at the side of the corneal incision. The same favorable termination is also seen in cases of traumatic perforation, other than operative; and sometimes in perforation due to small ulcers. The determining factor as to the occurrence of staphyloma appears to be the general condition of the cornea, and possibly of the iris, that becomes adherent to it. If these are the seat of extensive inflammatory changes, there is strong probability of increasing bulging of the cicatrix.

In young children the general adhesion of the iris to the cornea is followed by bulging of the whole cornea and even great enlargement of the eyeball; in older persons staphylomata are likely to be more strictly localized, and, if the bulging is great, they rupture.

Literature of '96 and '97.

Fine opacities upon the membrane of Descemet can be seen in all cases of iritis. They are usually overlooked, because the required examination is not made. The best method of examination is with the ophthalmoscope, a strong convex lens being used at the sight-hole. Such deposits appear early in iritis, frequently before synechiæ have been formed, and they disappear some time after the inflammation has subsided. Larger opacities are found in many cases. An irregular striated opacity of the cornea also attends certain cases of iritis. This opacity being situated in the proper corneal substance. H. Friedenwald (Archives of Ophth., Apr., '96).

The binocular magnifying lens not only allows the surgeon to discriminate by accurate recognition of the depth of a corneal opacity, but by its binocular impression causes points to be appreciated that would otherwise not attract the attention of the observer. E. Jackson (Trans. of Section on Ophthalmology, Amer. Med. Assoc., '97).

Opacity following the use of a lead lotion upon an ulcerated cornea has long been recognized and ascribed to the deposit of metallic lead in the denuded corneal tissue. But this explanation is now shown to be incorrect, for at least some of these cases.

Reports of a case of extensive aberration of the cornea treated by free instillation of a solution of sugar of lead, leading to a dense bluish-white opacity. This was removed by scraping, and examined chemically; but no lead could be detected. S. D. Risley (Wills Eye-Hospital Reports, '95).

Literature of '96 and '97.

A case of corneal ulceration was treated with iodoform ointment, but no preparation of lead was used. The lower half of the cornea presented a white metallic appearance like that

ascribed to the use of a lead lotion. Darier (Rev. Gén. d'Ophtal., July 31, '96).

A case of supposed simple conjunctivitis had been treated with a collyrium of zinc sulphate and belladonna. After six days a spot of chalky whiteness with sharply-defined edges, resembling a scale of porcelain, was noticed upon the cornea. At the end of five months it still remained, its surface having become roughened. Under cocaine it was detached, leaving a slight nebula. Chemical tests showed no trace of lead. H. Derby (Boston Med. and Surg. Jour., Apr. 22, '97).

Opacity from pigment-deposit in the cornea is of two kinds. In one, small spots of black or brown pigment are deposited in the cornea, late in the history of an intra-ocular inflammation which has usually been attended with high tension. Such pigment-deposits are likely to be permanent. A temporary general staining of the cornea by blood-pigment occurs after extensive hæmorrhage within the eyeball. The staining is at first comparatively uniform, and clears up from the margin of the cornea.

Literature of '96 and '97.

An acute glaucoma of eight weeks' standing had been treated with iridectomy, which was followed by a hæmorrhage's filling the anterior chamber. When the hæmorrhage was absorbed and the cornea cleared up, pigment-masses were noticed near the centre of the cornea and below it. These had their origin in dots of gray opacity, which were seen to become pigmented, and change in color from gray to brown and black. C. A. Wood (Annals of Ophth., Apr., '96).

An extensive prolapse of the iris through wound of the eye by scissors was removed by iridectomy. This was followed by repeated hæmorrhages into the anterior chamber, and subsequently the patient, a girl of $3\,^1/_2$ years, had measles. There was marked discoloration of the cornea beginning the tenth day after operation, and increasing until the membrane assumed a greenish-brown color, except near the corneal margin. At the end of fifteen months the blood-staining of the cornea had cleared up except at the centre, where there was an oval patch of brownish hue with sharply-marked edges; and this part had also become translucent. G. E. de Schweinitz (Ophthal. Record, Dec., '97).

Haziness of the cornea due to inflammatory deposit tends to clear up at first rapidly and then more slowly after the subsidence of the inflammation causing it. This tendency to clear up may be accelerated, or continued after it would otherwise cease, by certain applications to the cornea. One of the oldest, the dusting of calomel upon the surface, is still useful in the opacities left by phlyctenular keratitis. Other irritants have been used in a similar manner. Massage of the cornea, either by rubbing through the closed lid, or by stroking and rubbing the cornea with a corneal spatula, or specially devised instrument, has also a positive effect in renewing the process of absorption when this becomes sluggish. Electrolysis is also of marked value in clearing up such opacities, if they are unattended with anterior synechiæ, and especially if due to infiltration of the cornea rather than repair of extensive loss of substance by ulceration.

When it is impossible to secure further absorption of the opacity, it may be rendered less noticeable and annoying by tattooing the affected region.

Literature of '96 and '97.

Electrolysis superior to all the older remedies. The cathode should be applied to the eye by means of a small silver rod with a rounded end. The anode, an ordinary sponge disk, is applied to the opposite cheek. A pressure of $1\,^1/_2$ to 3 volts gives the necessary current, which should never be over $^1/_2$

milliampère. The eye is to be cocainized for the operation. Very dense opacities from sloughing and perforating ulcers regarded as hopeless. Edgar Stevenson (Brit. Med. Jour., vol. ii, p. 826, '96).

For opacities of the cornea resulting from severe episcleritis, peritomy resorted to. The sclera was denuded five millimetres back from the corneal margin and scraped with a curette. Only slight reaction followed, the inflammatory process ceased, and the cornea gradually cleared. D. H. Coover (Ophthalmic Record, May, '96).

[L. de Wecker insists that tattooing for optical purposes should be recognized as distinct from tattooing merely to improve the appearance of a sightless eye. He believes that, by rendering opaque the semitransparent corneal tissue in front of the pupil, the diffusion of light can be diminished and the acuteness of vision improved. Tattooing for this purpose may require to be combined with optical iridectomy or the division of the sphincter of the iris. In performing the operation the area to be tattooed must first be distinctly marked out, and then must be colored a uniform intense black. EDWARD JACKSON.]

Cornea, Tumors of.

New growths situated wholly or chiefly in the cornea are rare. They may be of importance because of the disfigurement they produce from interference with vision or by danger of extension when of a malignant character.

Frequently tumors of the conjunctiva extend over the cornea, and so belong partly to both regions. It has even been doubted whether primary tumors of the cornea ever occur. But well attested cases are on record. The most frequent form of corneal tumor is the dermoid, which usually starts about the sclero-corneal junction and extends both ways. It is generally believed to be always congenital; but may slowly increase in size for many years; such tumors are commonly removed for cosmetic reasons.

Literature of '96 and '97.

Such tumors may be located on the cornea alone or on the sclerotic alone, but the largest number involve both; being found most frequently at the outer and lower sclero-corneal margin. They are all congenital. A. R. Baker (Trans. Sec. on Ophth., Amer. Med. Assoc., p. 97, '96).

Case which was shown by the microscope to be a dermoid, but which was not congenital. It had been growing for ten years and was so large as to prevent closure of the lids. J. A. White (Trans. of Sec. on Ophthal., Amer. Med. Assoc., p. 97, '96).

Malignant neoplasms involving the cornea are usually secondary.

Perhaps carcinoma of the cornea is always secondary to such growths of the conjunctiva or some more distant part. Fibroma or sarcoma may be primary.

Literature of '96 and '97.

Report of a case of fibroma removed from the cornea of a woman, aged 50, where it had been slowly growing. The margin of the cornea, about one millimetre wide, was transparent all round. The tumor was flat, whitish, and two millimetres thick. It was easily dissected from the cornea, which was transparent, and its removal allowed the patient to read large letters. The microscope showed it to be purely fibrous, and derived probably from the corneal substance. D. Meigham (Glasgow Med. Jour., vol. ii, p. 223, '96).

Report of a case of primary sarcoma commencing at the corneal limbus. Twenty-two other cases found in literature. From a study of these, conclusion reached that sarcoma of the limbus is comparatively rare and remains confined to the external structures. Metastases practically never occur. Recurrences are frequent, but do not justify enucleation, unless the growth has attained extensive proportions or vision has been destroyed. A. N. Strouse (Archives of Ophth., p. 217, '97).

Corneal scars although often permanent, and, if large, subject to distension, very rarely become the seat of keloid changes. But a tumor of that kind is possible.

Literature of '96 and '97.

A girl suffered from ophthalmia neonatorum, which left the cornea opaque. For six months the scar did not change, and then it began to grow. At two years it looked like a large staphyloma, but when examined under anæsthesia was found to be a large tumor. On removal it was found almost eight millimetres thick. A microscopical examination showed it to be chiefly keloid. Two similar cases had been previously reported by Simon and Szokalski. C. D. Westcott (Annals of Ophthal., p. 472, '97).

EDWARD JACKSON,
Denver.

CORN-ERGOT AND CORN-SILK.—The Indian corn or maize (*Zea mays*) yields two medicinal substances: one when the plant is diseased with smut, the other only when in a healthy condition.

Ustilago maydis is a fungus growth: the ergot of corn, in fact. It occurs in globose masses, irregular, three to six inches thick, made up of nodular and globular, brownish-black spores inclosed in a blackish membrane. Its taste is unpleasant and its odor disagreeable. There is contained a volatile alkali, a fixed oil, and principle analogous to sclerotic acid.

Stigmata maydis, or "corn-silk," is the green pistils of maize-plant: a cereal that, though indigenous to North America, is now well-known in all quarters of the civilized globe. The pistils are of value only after they have shed their pollen.

Preparations and Doses.—Corn-ergot, powdered, 10 to 60 grains.

Corn-ergot, fluid extract, 10 to 60 minims.

Corn-silk, fluid extract, 1 to 2 drachms.

Corn-silk, infusion (1 to 8), *ad libitum*.

Corn-silk, syrup, 1 to 4 drachms.

Corn-silk, wine, 30 to 60 minims.

Physiological Action.—The action of corn-ergot appears to be relatively the same as that of ergot of rye, except that the contractions induced by the former are regularly intermittent, and those provoked by the latter are tonic. Corn-ergot by many is held to be quite as efficient and more uniform than its rye congener.

Corn-silk augments the secreting power of the kidney, and is likewise tonic to the secretory membrane; thus it is both diuretic and demulcent, and perhaps possessed of some antilithic power. Its diuretic action, if given in full doses, is both mild, certain, and rapid, whereby a debilitated kidney is not only relieved, but also an overburdened circulation: the pulse becomes more regular and the arterial tension stronger. It has no disturbing effect upon any organ; hence its tolerance is complete; and it can be taken for weeks without inconvenience of any kind. Some French authors assume it to be locally anodyne or anæsthetic, and to possess a peculiar elective action on the tissues of the ureter and bladder. It certainly is, in some degree, both antiseptic and antilithic.

Therapeutics.—The therapeutic properties of ustilago maydis may be said to be those of ergot, but to a milder degree. The claim has been made that, employed subcutaneously, the corn-smut is superior to that of rye in the treatment of uterine fibroids, but this lacks confirmation.

GENITO-URINARY MALADIES.—Corn-silk is serviceable in all inflammatory

conditions of the genito-urinary apparatus, acute or chronic, idiopathic or traumatic. It is especially valuable where intravesical decomposition of urine has given rise to irritation; and it may with advantage be combined with other antilithics in the treatment of gravel, etc.

CORYZA, ACUTE. See RHINITIS.

COTO-BARK. See PARACOTO.

COTTON-PLANT.—*Gossypium herbaceum* is a plant indigenous to the tropical and subtropical regions of Asia and Africa, and that by transplantation has become a native of the western hemisphere. It has long, petiolate, palmate, three- or five- lobed leaves of a green or dark-green color; the flowers are yellow. The bark of the root occurs in thin, flexible bands or quilled pieces, the outer surface brownish yellow, with slight, longitudinal ridges or meshes; small, black, circular dots; and dull, brownish-orange patches from the abrasions of the thin cork; inner surface whitish, of a silky lustre, and finely striate; bast-fibres long, tough, and separable into papery layers; inodorous; taste slightly acrid and astringent; seeds oblong or ovate, pointed at one end and covered with silvery-white hairs.

Preparations and Doses.—Cotton-root abstract, 3 to 15 grains.

Cotton-root extract, solid, 2 to 10 grains.

Cotton-root extract, fluid, 30 to 120 minims.

Cotton-root decoction (1 to 10), 4 to 16 drachms.

Cotton-root bark, powdered, 20 to 60 grains.

Cotton-root tincture (1 to 4), 1 to 4 drachms.

Cotton-seed extract, solid, 5 to 15 grains.

Cotton-seed oil, 2 to 16 drachms or more.

Cotton-leaves, tincture (expressed juice of fresh leaves, 1; proof-spirit, 8), 10 to 60 minims.

Gossypin (concentration), 1 to 5 grains.

Physiological Action. — Cotton-root bark is emmenagogic, oxytocic, ecbolic, and deobstruent. Its action is practically identical with that of ergot. It is safer than the latter, and operates without pain, but is not so active, especially during parturition. It also requires to be given in larger doses, and may be exhibited with impunity even in the first stage of labor. A decoction of the fresh root is more active than either the tincture or fluid extract.

The juice of the fresh leaves seems to exert a tonic alterative action on the intestinal tract, very like that of coto and paracoto, but less pronounced.

Cotton-seed oil is a *succedaneum* for olive-oil; it is bland and nutritious, also slightly expectorant, markedly galactagogic and aphrodisiac. An extract made from cotton-seed exhibits these properties in greater or less degree.

Therapeutics.—The therapeutic indications are the same as for ergot as regards preparations of the root. The fresh leaves are employed internally in dysentery and diarrhœas, externally to inflamed joints, the breasts of nursing women to promote the secretion of milk, and to boils and abscesses to hasten their maturation. Cotton-seed oil finds its chief use in the preparation of liniments.

PARTURITION. — Cotton-root bark is mild and certain in action, and does not produce the well-known, rapid con-

vulsive action of ergot; but, on the contrary, seems to greatly stimulate the uterus to normal function. It acts not alone upon the uterine muscles, but also upon the secretory function.

Gossypin represents the emmenagogic and parturient principle of cotton-root bark; but, unfortunately, as generally found in shops, owing to improper methods of manufacture, is seldom to be relied upon.

COUCH-GRASS. See TRITICUM REPENS.

COWPERITIS. See URETHRITIS.

COW-POX. See VACCINIA.

COXALGIA. See HIP-JOINT.

COXITIS. See HIP-JOINT.

CREASOTE.—Commercial creasote is obtained during the dry distillation of wood-tar, or from crude pyroligneous acid. Medicinal creasote is, or should be, obtained from the distillation of the tar of the beech (*Fagus sylvatica*). The substance is exceedingly complex, being a mixture of phenols, chiefly guaiacol and cresol.

Pure creasote is a colorless, oleaginous liquid of burning taste and possessed of a disagreeable penetrating, smoky odor that is most characteristic. Its specific gravity is 1.080, but much of that sold as pure creasote will be found to vary from 1.035 to 1.085. With age it acquires a yellowish hue, and if continuously exposed to light and air it becomes of a deep-reddish brown, when it is unfit for medicinal use. It is but sparingly miscible with water, perhaps 1 to 130 up to 150, but is soluble in all proportions in alcohol, ether, petroleum-spirit, and glacial acetic acid. It is often substituted for by crude phenol, to which it is intimately related, both chemically and therapeutically. The fraud may be detected by the simple fact that the latter is soluble in glycerin, while creasote is not. Again, creasote does precipitate nitrocellulose from collodion, and gives a green reaction with a weak alcoholic solution of ferric chloride; phenol gelatinizes collodion and, with the iron test, yields a brown reaction.

Creasote is incompatible with strong mineral acids, and reduces some of the metallic salts,—silver nitrate, for instance. With silver oxide, explosion and deflagration result.

Preparations and Doses. — Creasote (pure beech-wood), 1 to 3 minims.

Creasote benzoate, topical use only.

Creasote carbonate (cresalol), 5 to 20 minims.

Creasote - calcium chlorohydrophosphate, 3 to 8 grains in emulsion.

Creasote codliver-oil (creasote, 15; codliver-oil, 1000 parts), 1 to 4 drachms.

Creasote elixir (creasote, 15; rum, 1000 parts), 1 to 4 drachms.

Creasote ointment, simple (creasote, 1; simple cerate or other fat base, 8 parts).

Creasote ointment, *fortior*: used for psoriasis and skin diseases of like character only (creasote, 60 grains; yellow wax, 30 grains).

Creasote oleate (oleocreasote), 20 to 120 minims).

Creasote pills (creasote and curd-soap, of each, 120 grains; make 2-grain pills), 1 to 3.

Creasote valerianate, 2 to 10 minims.

Creasote-water (creasote, 10; distilled or flavored water, 990 parts), 1 to 4 drachms.

Creasol, 5 to 10 grains.

Cresol, external use solely.

Creasol iodide (losophan), external use.

Cresol-salicylate (cresalol), 2 to 10 grains.

Cresotic acid, disinfectant only.

Guaiacol (liquid), 2 to 5 minims. See GUAIACOL.

Guaiacol benzoate (benzosal; benzoyl-guaiacol), 4 to 10 grains.

Guaiacol biniodide (deuto-iodide), 1 to 3 grains.

Guaiacol-carbonate, 3 to 8 grains.

Guaiacol-phosphate, 2 to 8 grains.

Guaiacol-salol, 5 to 15 grains.

Cresol, meta-, ortho-, para-, are disinfectants only.

Paracreasotate of sodium, 1 to 15 grains. See SODIUM.

Paracreasotic (creasotinic) acid, 10 to 40 grains.

Creasote carbonate, or cresolal, is a light-brown, viscous liquid, almost odorless and tasteless, insoluble in water, but soluble in oils; it contains carbonates, guaiacol and cresol, and is employed as a substitute for creasote proper. It is generally stated that it may be administered in large doses for a lengthened period without untoward result—that it will not in any way disturb the economy, no matter what the amount ingested; but this must be taken *cum grana*, since it is based solely upon the *dicta* of interested manufacturers and purveyors. Besides, it is contrary to the rules of evidence.

Creasote-calcium chlorohydrophosphate forms a white, syrupy mass, but presents no advantages over creasote.

Creasote oleate, or oleocreasote, also known as creasote-oleic ether, is obtained as a yellowish, oily liquid of a specific gravity of 0.950 at 59° F., soluble in ether, chloroform, and benzene; consequently it can only be administered in emulsion.

Creasote valerianate possesses about the same value—at higher market-price—as creasote carbonate, but is supposed to combine also the effect of valerianic acid, though this must necessarily be universal.

Creasol is obtained by heating beechwood creasote with tannic acid and phosphorus oxychloride. It is a dark-brown, very hygroscopic powder, with creasote odor and taste, soluble in water, alcohol, glycerin, and acetone; and insoluble in ether. It is held to be astringent and antiseptic.

Cresol, which is merely an antiseptic for external use, differs from creasol in that it is a yellow, aromatic liquid possessed of a vanilla-like odor.

Cresalol, paracreasalol, or paracresylic ether of salicylic acid, is a condensation of salicylic acid with paracresol, whereby is obtained a whitish, crystalline powder or white needles. It is insoluble in water, but freely soluble in alcohol and ether, and melts at about 39° or 40° F. It was introduced as a substitute for salol, but seems not to have received any great confidence on the part of the medical profession.

For "guaiacol" see GUAIACOL.

Creasotic, cresotic, or paracresotic acid—the paracresol of French authors—is a homologue of salicylic acid, and is obtained in long, white, prismatic needles that are soluble in alcohol, ether, and chloroform. In minute doses it is employed as an antiseptic, in larger doses as an antipyretic. The maximum dose during twenty-four hours is 60 grains.

Creasotinic acid, also known as oxytolutic or homosalicylic acid, is the same as the foregoing; is also obtained as an ortho-, meta-, or para- modification; hence is frequently designated in the plural as "creasotic acids." The para compound only finds place in medicine, but its place for the most part is usurped by its sodium salt.

Creasote is largely administered in pillular form, which, however, is objection-

able for two reasons: First, no suitable excipient is known: Second, creasote pills are variable in strength and by no means stable, besides being nauseous.

Literature of '96 and '97.

Examination of nine commercial samples of creasote pills made employing one hundred of each sample. The variations were as follow:—

	Amount of creasote claimed	Present
I.....	5.00	4.92
II.....	2.50	2.30
III.....	10.00	9.60
IV.....	5.00	4.70
V.....	5.00	1.65
VI.....	5.00	2.25
VII.....	5.00	3.14
VIII.....	5.00	4.30
IX.....	5.00	4.70

Beckurts (Apoth. Zeit., '96; Med. Age, Nov. 25, '96).

In prescribing creasote it must be borne in mind that the ordinary commercial article is derived from pine, and unfit to be employed medicinally, except, perhaps, topically. Medicinal creasote is always understood to be the beech-wood product.

Undoubtedly the best method of administration is in some fluid—in codliver-oil, in emulsion, in elixir, or as combination of the elixir and codliver-oil.

An emulsion may be prepared by making two solutions—one equal parts of alcohol and creasote, the other equal parts of water and saccharate of casein—and shaking together. This should then be diluted with water, in the proportion of 1 quart to 10 drachms of the emulsion. The dose is 1 drachm mixed with milk or from 3 to 4 ounces administered by enema. Lêger (L'Union Pharm., July 15, '93).

A palatable mixture is the following: Creasote and glacial acetic acid, of each, 15 minims; spirit of juniper, 30 minims; syrup, 1 ounce; distilled water, 15 ounces. The dose is 1 to 2 ounces. Whitla ("Pharm., Mat. Med., and Therap.," 92).

It has been proposed to administer creasote in "enteric coated" pill,—*i.e.*, a pill that will only dissolve in intestinal fluids; but such pill coating is theoretical only, and all those that have been exploited have proved failures. They are based upon the assumption that the normal intestinal secretions are invariably acid, which is far from being true; indeed, the opposite is the fact.

Hypodermic Use.—Formerly creasote was employed subcutaneously only when added to other remedies to preserve the solution. An old formula was 10 grains of morphine in 60 minims of creasote, of which the dose was 6 minims, but its injection was extremely painful and produced an elevation of the skin resulting in a yellow pustule which, though it subsided on the second day, was succeeded by sloughing, redness, infiltration, and thickening. Only sciatica could justify this measure. But, when the drug began to be employed for phthisis, the following found favor among French practitioners:—

℞ Dried pepsin, 20 grains.
Morphine muriate, 1 grain.
Beech-creasote, 6 minims.
Glycerin (neutral), 154 minims.
Alcohol, 20 minims.
Water, enough to make 224 minims.

Dose, 16 minims, five or six times daily, injected deep into the muscular substance. The morphine is often left out, its sole purpose being the obtunding of the pain that supervenes after the operation.

Literature of '96 and '97.

So far as giving creasote by hypodermic injection is concerned, it is a perfectly-rational procedure and may be

done without harm, but it possesses no advantage over administering the drug by the mouth, and it cannot be continued for a long period of time. It may be mixed with an equal quantity of oil of sweet almonds, and 10 minims of this may be injected deep in the tissues of the back, though some prefer a solution less concentrated. Peror uses a 10-per-cent. solution in oil of sweet almonds and injects 80 minims twice a day. Griffin (Foster's "Prac. Therap.," vol. i, '96).

Physiological Action.—Topically, creasote is caustic, antipruritic, analgesic, astringent, and markedly antiseptic and germicide. Taken internally, in small doses it is expectorant and a cardiac and nerve-stimulant; besides, it is cooling and sedative to the stomach, from which it is readily absorbed into the circulation and then diffused with great celerity; it is styptic, increasing the coagulability of the blood. Larger doses depress the heart and nervous system, but accelerate respiration and render it full, with perhaps a secondary result which entirely reverses the order; it stimulates the vagi both at the periphery and centre. It is eliminated chiefly by the kidneys and lungs. Its beneficial effects cannot be attributed to any antibacillary action, since it does not diminish the number of the bacilli of tuberculosis nor even diminish their virulence.

Creasote is eliminated in the form of sulphate of guaiacol and cresol-potassium sulphate, but when the change occurs is difficult to determine; it certainly does not take place entirely in the liver, since it as readily occurs when it is used by enema or subcutaneously; probably it takes place in the tissues. Imbert (Bull. Gén. de Thér., June 15, '92).

Creasote is eliminated by the kidneys no matter how administered, and the largest amount thrown out is during the first twelve hours after administration. The elimination by the lungs is comparatively insignificant. The guaiacol element appears to be most rapidly eliminated. Imbert (Nouv. Montpellier Méd., '92; Ther. Gaz., Mar., '92).

Poisoning by Creasote.—When toxic quantities are ingested, the heart and circulation are powerfully depressed, the temperature is lowered several degrees, the pupils are minutely contracted, and respiration is paralyzed. This is also the case with the vasomotor centre of the medulla; there is first vertigo, later stupor. Owing to stimulation of the anterior cornu of the cord, muscular tremblings and even convulsions may supervene.

Some persons seem very sensitive to the action of creasote, while others appear to tolerate it in enormous doses; hence the problem of elimination should be taken into account on all occasions where the drug is prescribed.

Case of a woman, 42 years of age, who was ordered creasote in 6-drop doses. Toxic symptoms supervened after the third dose, including evidence of gastro-intestinal irritation, anæsthesia, albuminuria, cardiac insufficiency, persistent burning in mucous membrane of mouth and pharynx, and exhalations by the mouth tainted with odor of the drug. Death supervened after four days. Zawadski (Kronika Lekarska, '94).

Two cases of pulmonary tuberculosis treated by rectal injections of creasote, 30 minims daily. The urine soon became black, though clear when first passed, and resembled that excreted in carbolic-acid poisoning. Even after the substitution of guaiacol for creasote, one case continued to pass urine that became black. Nimier (L'Union Méd., Aug. 31, '95).

Literature of '96-'97-'98.

Case of a man, aged 35, suffering from phthisis pulmonalis, who commenced to use creasote in doses of 1 minim thrice daily, and rapidly increased the same until he was ingesting exactly 340 minims every twenty-four hours. During two and one-half months he con-

tinued to take 3 and 4 fluidrachms daily, and then he reduced to 140 minims, which he still continues. He has never experienced any ill effects. Graham (Brit. Med. Jour., Jan. 15, '98).

Stertorous breathing; cold, clammy skin; pinched face, anxious expression, abolition of reflexes; weak, thready, and often imperceptible pulse; feeble respiration, and, above all, the odor of the drug are the prominent symptoms of poisoning. Death occurs from failure of respiration, and the heart is arrested in diastole.

Treatment of Poisoning.—If seen in time, the stomach should at once be washed out. Epsom salt, demulcent drinks, heat to body and limbs, and atropine and strychnine hypodermically are indicated; coffee, digitalis, and opium for the relief of pain, are often demanded.

By experiments on animals it was found that the soluble sulphates which are so often efficacious in carbolic-acid poisoning are equally so as regards poisoning by creasote. Hare (Univ. Med. Mag., Apr., '89).

Derivatives.—The creasote preparations and derivatives differ little from the drug itself as to physiological action. Most have been exploited on the score of greater palatability or as being less noxious, but the evidence as regards the latter rests upon a very slender foundation. Creasol is more astringent, and creasote carbonate more palatable.

Literature of '96 and '97.

Creasote carbonate is better borne than ordinary beech-wood creasote. It has, in many cases, a tendency to diminish secretion; it seems to have no influence upon peristalsis. Occasionally it excites fluid stools, but these vanish in one or two days and normal evacuations succeed; occasionally it appears to induce costiveness. There is no unpleasant action on the stomach: eructations and vomiting are rare, and only appear after large doses have been ingested, and even then rapidly disappear without withdrawal of the remedy. It increases appetite, diminishes and deodorizes the secretion of lung and kidney, and exerts generally a favorable effect upon nutrition. Reiner (Ther. Woch., Jan., '96).

Paracreasotic or creasotinic acid has been employed along the same lines as creasote carbonate.

No marked effect is produced upon the healthy human organism by doses of 40 to 60 grains, with the exception of a feeling of great fullness of the blood-vessels of the skin, a light pulsation of the arteries, and a moderate perspiration. No influence is exercised on the digestive functions. In some cases, however, the drug induced collapse and erythematous eruption. As a rule, children bear the drug well. Thus in a boy, 12 years old, 15 grains were given every five hours, and even larger doses produced no after-affects. The temperature was reduced 2 degrees. Demme (Wiener med. Blatt., Apr. 15, '90).

Cresotic (not Creasotic) Acids—Para- and Ortho-.—A proposal to utilize these chemical compounds as remedies for internal administration, led to a study of their effects. These seem to centralize upon the spinal cord.

The fatal dose of paracresotic acid is about 3 grains per pound-weight of animal; double this killed a rabbit of 2½ pounds in three hours, and 12 grains, in the same time, one a pound heavier. One grain of the ortho-acid per pound of body-weight is sufficient to cause death in from twelve to thirty-six hours, this being preceded by symptoms of paralysis, especially of forelimbs. A combination of both drugs resulted in increased poisonous properties. Charteris (Brit. Med. Jour., Mar. 28, '91).

Therapeutics. — Gastro-Intestinal Disorders.—In vomiting, gastrodynia, nausea, etc., creasote is a remedy of great power and an excellent rival of hydrocyanic acid. Even in the vomiting at-

tendant on malignant disease of the stomach, duodenum, liver, or pancreas, it is often most effective, though the relief afforded is necessarily but temporary. In the diarrhœas of children and infants, especially those peculiar to the heated term, it is of great utility, and not infrequently it serves a most excellent purpose in the management of tropical diarrhœa and dysenteries.

Literature of '96 and '97.

Although rarely employed in diseases of the digestive tract, save to check vomiting, creasote is often serviceable in infantile gastro-enteritis and various dyspeptic conditions. Zaugger (La Sem. Méd., '97; Med. Age, Nov. 10, '97).

HÆMORRHAGES.—Here the drug has been employed with great advantage, both topically and internally. Few remedies are so valuable in hæmoptysis, in hæmatemesis, hæmaturia; it is invaluable in the washing out of bladder, intestinal hæmorrhages of continued fever, etc. In superficial bleedings from wounds, leech-bites, after the extraction of teeth, the topical application is almost magical in results; and the late McCormack, by its aid, once arrested hæmorrhage from the carotid artery. Though there is no definite record of its use in cases of hæmophilia, such would seem to have definite basis, though from a palliative rather than remedial standpoint.

DIABETES.—It has been observed when this drug is administered in small doses, thrice daily, in diabetes, gradually increasing by 1 drop every alternate day until the point of toleration is reached, that it has a very beneficial action on diabetes; but aperients should be frequently employed in order to assist elimination by the bowels. Usually the urine is much improved in quantity and character, and there is frequent micturition.

Creasote, when administered internally, is of considerable value in the treatment of diabetes mellitus. In two cases 4 drops were given daily, and gradually increased 10 minims, under which the sugar gradually disappeared from the urine, and even a return to starchy food did not cause any reappearance of saccharine matter. Valentini (Les Nouv. Remèdes, Mar. 8, '91).

VENEREAL DISEASES.—In gonorrhœa, blennorrhœa, gleet, etc., especially the chronic stage of the former, creasote is often of greater benefit than cubebs, copaiba, santal-wood oil, and the like, and it may be employed both by the mouth and by urethral injection. It is especially available in gonorrhœa of the female; in leucorrhœas, etc., and as a wash and gargle to syphilitic lesions of all forms, especially specific ozæna.

Literature of '96 and '97.

Fifty cases of gonorrhœa in the male that were successfully treated with injections of emulsion of creasote, 2 to 10 per 1000. The discharge quickly decreased, became mucoid, and then ceased altogether. The patients recovered more rapidly than under ordinary methods and without a single complication or relapse. The creasote seems to exercise an anæsthetic action on urethral mucous membrane. Larska (Med. Oboz., '96; Med. Age, Jan. 25, '97).

CYSTITIS.—Inasmuch as creasote and its derivatives when administered by the stomach tend to prevent decomposition of urine, it has been suggested they may prove useful in cystitis, enlarged prostate, and paralyzed bladder.

SEPTIC DISEASES.—The value of the drug in the management of all forms of sepsis cannot be too highly extolled. It is one of the very few agents that make an impression on glanders in the human subject, and it is even more effective in anthrax, puerperal fever, carbuncle, etc.,

and may be employed both internally and topically.

It has also been employed, locally and internally, in erysipelas, including the phlegmonous form, in phlegmasia dolens, and puerperal fever. In idiopathic erysipelas it should be applied pure, or sufficiently strong to render the cuticle white immediately it is touched, and penciled over the whole of the inflamed surface, even beyond it. In the phlegmonous form the applications should be more frequent, and compresses soaked in weak alcohol (in which a little creasote may be dissolved) kept constantly applied.

Skin Diseases.—Creasote long enjoyed considerable celebrity as a remedy for lepra, psoriasis, impetigo, acne, prurigo senilis, ephelis, tinea in all its forms, sycosis, and scabies, but of late years it has been little employed, owing, in part, to its disagreeable odor and the difficulty encountered in securing a pure product, and partly to the fact that its place has been usurped by carbolic acid. The stronger creasote ointment (creasote, 1 drachm; yellow wax, 30 grains) is more especially intended for use in lepra, psoriasis, and tinea tricophytina, but should never be applied to the face, the neck, the abdomen, or the flexor surface of the limbs.

Ulcerations.—Non-specific sloughing and phagedenic ulcerations are often greatly benefited by the stronger ointment of creasote, or even by pure creasote, locally applied; they become clean, and long-standing ones heal rapidly. To indolent and mild ulcers, weak solutions, or the elixir may be applied; the same appears efficacious in the management of bed-sores, and it has even been claimed that sponging with a 1 to 80 lotion will prevent their formation.

As stimulants, antiseptics, and escharotics, applications of creasote are often made which range in strength, according to the severity of the case and the sensitiveness of the part, from 1 drop to 1 ounce of water, up to the pure drug. Thus are treated a large number of morbid conditions, among them indolent and sloughing ulcers, fistulæ, gangrenous surfaces, leucorrhœa, puerperal metritis, fœtid otorrhœa, diphtheria, burns with excessive suppuration and redundant granulations, and chilblains, and to wash out the pleura in cases of empyema.

Ulcers of the larynx, whether tubercular or not, may be treated by the application of creasote, and a solution containing 1 or 2 drops of creasote to 1 ounce of water is useful as a stimulating and disinfecting gargle.

Tumors and excrescences have been treated by the local application or injection of creasote, with more or less success, yet there are so many remedies of more pleasant character that the method has been practically abandoned.

Pulmonary Diseases.—It is in diseases of the respiratory tract that the remedy has gained greatest repute in late years. Inasmuch as it is eliminated by the bronchial mucous membrane, which it stimulates, it is an expectorant of great value, especially so if there be any fœtor of the secretion. In full doses it is the most valuable of all remedies in chronic basilar cavities. It is strongly recommended in pulmonary, laryngeal, and abdominal tuberculosis, and there is little doubt that it is one of the best agents yet introduced for the treatment of ordinary phthisis and of bronchiectasis, bronchorrhœa, broncho-pneumonia, and some forms of bronchitis. The greatest drawback to the use of the drug is the inability of many patients to take it in doses sufficient, either as to amount or to their continuance, to be of

benefit. The different modes of administration that have been advocated, except that by the mouth, are all objectionable; the rectum is even more intolerant than the stomach, and after a few days the patient loses control of the bowel and is frequently attacked by colic and diarrhœa. With subcutaneous injections, the risk is run of inducing gangrene or abscess, and the pain is not alone considerable, but often excruciating. Injection into the trachea, which has been suggested, has not as yet been sufficiently tried to warrant more than a mention. The subject will be taken up exhaustively when the various forms of pulmonary phthisis are studied.

Intratracheal injections of creasoted oil (1 to 20) are admirably borne by the majority; 30 minims may be employed twice daily. No complications are provoked, and the patients never had hæmoptysis, fever, stitch in side, or digestive trouble. Experiments showed that the oil reached the alveoli, and stayed there fifteen days. The injections should be practiced during many months, and it is necessary to auscultate the patients frequently and make them take a position that will allow the oil to penetrate to the diseased portions of the lungs; it is often possible to determine whether the oil has reached the part by the production of bubbling râles. Under this treatment the majority of cases improve, appetite returns, weight is increased, and expectoration is diminished; but it is those in the first or second stage of tuberculosis who are most benefited. Dor (Rev. de Méd., Feb., '90).

In the treatment of phthisis creasote may be said to have superseded all other remedies. When used in the earlier stages of the disease, along with other measures, out-of-door life, proper food, etc., it is undoubtedly able to afford cures.

Creasote has done more for the treatment of phthisis than any other remedy. Jumon (La France Méd. et Paris Méd., Sept. 12, '89).

Of 93 phthisical patients treated by creasote 54 were benefited and 25 apparently cured. Bouchard (Archiv. Clin. de Bordeaux, Mar., '89).

Thirty-four cases treated by inhalation of: eucalyptus, turpentine, and creasote, of each, 5 drachms; iodoform, 7½ grains; sulphuric ether, 75 grains. Of these, 5 died, 10 remained stationary, 13 were improved, and 6 cured. Petresco (Bull. Gén. de Thér., Oct. 15, '89).

By the hypodermic use of a 10-per-cent. solution of creasote in oil of sweet almonds, making the injection into the cellular tissue of the external iliac fossa, the medicament can be introduced into the circulation without any derangement of digestion. At least two injections, each of 75 minims of the solution, should be given daily. Perron (Gaz. Heb. des Scien. Méd., May 25, '90).

Subcutaneous injections of creasoted oil gives excellent results in the treatment of all wasting diseases, pulmonary or otherwise. The injections are followed by local and general effects, but never of serious nature; absorption is more or less rapid, and no abscess produced. The best results are had in apyretic phthisis, with or without abundant expectoration. Guerder (Jour. de Méd., May 3, '91).

In upward of one hundred cases of tuberculosis treated with creasote improvement was observed in all, though no cures were effected, owing to the advanced stages of the disease. Many who would have died but for the use of the drug were able to resume their accustomed vocations. Penrose (Med. Rec., Apr. 9, '92).

All the elements of creasote are irritant and feebly poisonous, and are of some value in tubercular phthisis, but the entire creasote is superior to all, being the most active. Main (Bull. Gén. de Thér., Mar. 15, '92).

The reputation of creasote as an antituberculous remedy is firmly established; it is of especial service in the initial stage of phthisis and may be prescribed in rather large doses for a prolonged period. It is a prophylactic in pretubercular anæmia. Stark (Ther. Gaz., Dec., '92).

While the drug is of great service as

an expectorant stomachic tonic and symptomatic remedy generally, it has scarcely an influence upon the progress of phthisis. Though during its administration increase of weight and an improvement in general health may be observed, it is by no means certain whether this is due to the drug or to improved care as to hygiene, alimentation, etc. It is more uncertain since the progress of the disease is very capricious, and the periods of improvement and aggravation depend much upon the individuality of the patient. As regards "specific action," this may be denied, for it does not dinish the number of tubercular bacilli nor attenuate their virulence. Weyl and Alba (Berliner klin. Woch., No. 51, '92).

Creasote diminishes expectoration, lessening its purulency and the tendency to hæmorrhage. Burney Yeo ("Man. Prac. Treat.," vol. ii, '92).

In a series of one hundred cases it was noted that its chief action was to lessen cough and expectoration, without influencing the progress of the disease. Osler ("Prac. of Med.," '92).

It certainly exerts a curative influence on the tubercular lesion and, besides lessening expectoration, purulency, and the tendency to night-sweats, it seems to diminish the number of tubercular bacilli. Jaccoud (Bull. Gén. de Thér., '92).

Creasote is, by long odds, the most important therapeutic agent ever employed in phthisis; it, codliver-oil, and whisky offer a triad of wondrous utility when skillfully employed. Thereby the sputum is much diminished in quantity, improved in quality, and facilitated in ejection; the appetite is increased, digestion strengthened, and fever diminished. But creasote should never be administered on a fasting or disordered stomach. Mulhall (St. Louis Clinique, '94; Med. Age, Jan. 25, '95).

Pure creasote, properly and systematically administered, is, without doubt, one of the most reliable of remedies; and failure therefrom is due to employment of a non-reliable product, or neglect of proper administration. Ingraham (Med. News, vol. lxx, '95; Med. Age, May 10, '95).

Creasote used in nearly four hundred cases, including not only the pulmonary form, but tubercular disease of the peritoneum, the joints, the bones, the glands, and the larynx. Great care is demanded, both as to the method of administration and the quality of the drug. A convenient way of prescribing it is in capsules containing 2 or 4 minims of creasote mixed with codliver-oil; and these should always be given immediately after eating and never on an empty stomach. After several days complete tolerance is established, and within four or five days the dose can be gradually increased, until finally the stomach improves in every way, and all irritation with the accompanying indigestion has been relieved. In regard to the method of increasing the dose, the following rule will be found to work well: Begin with 2-minim doses three times a day; in acute cases increase the dose by 2 minims every fourth day until 12 minims are given at one time; then observe the results of the largest dose for several weeks, and, if the improvement is not satisfactory, carefully add 2 minims more every eight or nine days until a 20-minim dose has been reached; then persist with this quantity until the symptoms warrant a diminution of the amount. The highest dose has frequently been used for four or five months at a time before decreasing it, with the most satisfactory results. The chronic cases do not, as a rule, require so large a dose, or to have it so rapidly increased. In average chronic cases the patients use 12 minims three times a day, beginning with 2 minims, increasing by 2 minims every six days to 8 minims, then every second week to 12 minims, according to the effect. During the first week or ten days there are troublesome eructations of gas flavored with creasote, but not a single instance has been seen where this did not entirely subside after the creasote had corrected the fermentation caused by old indigestion. Conway (N. Y. Med. Jour., June 1, '95).

When tuberculosis of the larynx complicates the pulmonary trouble, creasote

should be employed locally as well. The fact should be borne in mind, however, that the benefit observed will mainly depend upon the internal administration of the remedy, though the local applications greatly assist the curative process.

Creasote is quite as efficient in laryngeal tuberculosis as it is in the pulmonary form, but should be used both internally and topically. For the latter an oily solution is preferred, such as

℞ Beech-wood creasote, 2 drachms.
Oil of wintergreen, 2 drachms.
Hydrocarbon-oil, 1 drachm.
Castor-oil, 3 drachms.

The oil of wintergreen and castor-oil should first be mixed together, then the hydrocarbon oil added, and, lastly, the creasote. Sterilizing the solution by dry heat gives it a much clearer appearance; besides it is very fluid and non-irritating, of pleasant odor and taste. It may be used as a spray, or applied with a laryngeal applicator or as a submucous injection. Topical application alone may be relied on for the successful relief of the symptoms of primary tubercular deposits with infiltration and hypertrophy of the mucous membrane, provided the temperature is not high and the general condition is good. If, on the other hand, the evening temperature is high and the case seemingly progressing to active ulceration, a few submucous injections should be used as adjuncts to local treatment. The cough, laryngeal soreness, and moderate dysphagia of primary cases are quickly relieved by sprays of creasote, but resolution of their infiltrations and hypertrophies is not so rapid. In several patients laryngeal distress was relieved after a few applications, but the infiltration continued for months.

The interior of the larynx should be thoroughly cleansed before any treatment is undertaken. Applications may be made by means of down sprays, of the laryngeal syringe, or by absorbent cotton on an applicator; but the latter occasionally produces an undesirable amount of coughing. An 8- or 10-per-cent. solution of cocaine should first be carefully applied to the larynx, and, after it has had time to produce moderate anæsthesia, the spray of creasote (2 drachms to the ounce) is used. After the spray the pyriform sinuses may be filled with creasote solution, and also some of it allowed to drop into the trachea through the opening of a gum-elastic tip drawn over the cannula of the syringe. This keeps the laryngeal surfaces bathed in creasote for a considerable period, and the patient should, if possible, be kept perfectly quiet and not allowed to talk or swallow for half an hour afterward. The stronger solution of creasote may be used every third or fourth day and the weaker ones every day or so, depending entirely on the amount of stimulation it produces; the laryngeal membrane becomes very red and considerably swelled from too-frequent applications. In the ulcerative stages of laryngeal tuberculosis sprays of a drachm of creasote to the ounce may be used daily with advantage; but if there is no ulcerative process a personal experience of each must decide the frequency of the applications. A slight burning sensation follows, but it only lasts a few minutes; and the disagreeable taste is very effectually covered by the wintergreen-oil. Where there is ulcerations, both topical applications and submucous injections are advisable, as they hasten the separation of sloughing tissue, stimulate healthy granulation, and at the same time arrest progress. The injection should be as superficial as possible, as the primary tubercular deposit is immediately beneath the epithelial layer. Weak solutions of cocaine may be sufficient in some cases, but complete anæsthesia is usually necessary, and 20-per-cent. solutions are generally the most satisfactory, administered on an applicator,—although it may be safe to employ the spray if the physician is well acquainted with his patient. Little pain or reaction follows the injection of oily solutions, but pure creasote causes a burning sensation and considerable soreness, which lasts a variable time. Much depends on the locality of the injection; the posterior surface of the arytenoids seems to be specially sensitive. There is little or no hæmorrhage

after the needle is removed, and on the following day the mucous membrane is more tense and possibly somewhat redder. This condition subsides in the course of a few days, leaving the tissues in a wrinkled condition, as if the mucous membrane were too large for the subjacent parts. This is most noticeable around the arytenoids. Careful judgment is required to determine how often the injections should be given, but, as a rule, it should be once in five or six days. If ulceration is proceeding rapidly, one injection may be given daily until three or four have been administered. After several injections it is well to wait for a time and see if the circle of resolution will not spread from the point of injection to the neighboring tissues.

The ventricular bands usually require superficial and deep injections, the former to reach the deposits in the bands, and the latter the ventricles of the larynx. The interarytenoid space should be treated from below upward, otherwise it would be impossible to obtain a good view after the first injection. Very superficial puncture should be made in the mucous membrane covering the arytenoids, as it is an easy matter to start a perichondritis in this situation. A row of injections should first be made around the base of the arytenoid cartilages and gradually approach their tips. Tubercular infiltration of the epiglottis renders it so thick and firm that it is capable of bearing considerable pressure and is readily subjected to this treatment. A single row of injections may be made around the free border of the epiglottis about half an inch apart. The lingual surface of the epiglottis is very accessible for injection, but the laryngeal surface is not so easily reached. If the anæsthesia is complete the epiglottis may, in some cases, be pulled forward sufficiently by the shank of the needle for the injections to be made. If this cannot be effected, the needle may be pushed through the cartilage from its lingual surface. After the injections the larynx should be kept as clean as possible, and sprayed every day or so with the weaker solution of creasote. Chappell (N. Y. Med. Jour., Mar. 30, '95).

Literature of '96 and '97.

Creasote in lung affections is somewhat discounted by the irritant effects of large doses, leading to chronic inflammation of the alimentary tract. Creasotal (creasote carbonate) was introduced to overcome this advantage, and it breaks up in the intestine into creasote and carbonic acid. The decomposition is a slow one; so that the organism is more or less continuously under the influence of creasote, which is excreted by the lungs and kidneys. It may be given alone in teaspoonfuls, or, if the patient is very susceptible to its slight taste, this may be covered by milk, sweet wine, etc. Very large doses (even 300 grains per day) can be administered without upsetting the digestion. Just at first there may be some nausea or even vomiting, but these do not contra-indicate the continued use of the drug, as they soon pass off. Creasote carbonate has precisely the same specific action upon pulmonary tuberculosis as creasote; in addition it is of exceptional value in the symptomatic treatment, diminishing and deodorizing the expectoration and improving the appetite, which may even become ravenous by its use. It has a favorable influence on the general condition, improving nutrition and leading to increase of body-weight, and so indirectly limiting the spread of the lung affection. It is to be preferred to creasote because of its milder action, and is indicated in cases where the latter is tolerated with difficulty or not at all. Reiner (Inter. klin. Rund., Sept. 15, '95; Brit. Med. Jour., Jan. 25, '96).

Creasote valerianate may be given in capsules, 3 minims thrice daily, and slowly increased until from 25 to 30 minims can be taken during the twenty-four hours. Its use with thirty-five patients evidences it as an excellent substitute for pure creasote. Grawitz (Ther. Monats., vol. vii, '96).

Creasote possesses undoubted power to relieve the fœtor of foul expectoration in bronchiectasis and phthisis. It modifies in a very appreciable manner the ordinary course of the latter disease. Shrady (Med. Rec., June, '96).

In chronic bronchitis, in gangrene of

lung, and phthisis, the following has been found very useful:—

℞ Creasote, 1 minim.
Laudanum, 2 minims.
Chloroform spirit, 15 minims.
Glycerin, 1 drachm.
Water, to make 1 ounce.
M. For one or two doses.

To allay the irritating cough of phthisis, recourse may be had to a linctus:—

℞ Creasote, 1 minim.
Glycerin, 56 minims.
Water, 1 ounce.
M. To make eight doses.

Murrell ("Manual of Mat. Med. and Therap.," '96).

Creasote is one of the most efficient remedies in pulmonary tuberculosis. Probably no one drug exerts so favorable an action on the night-sweats, cough, and expectoration. It is of less value in cases accompanied by high temperature and hæmoptysis, and often aggravates these symptoms. It must be remembered that many of the cases alleged to have been cured by creasote have been treated with codliver-oil, tonics, and hygienic method, as well. In any event, large doses are necessary, and tolerance can usually be established by gradually increasing. Capsules are the least offensive mode of administration, though some persons prefer to take the drug in milk. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Creasote in full doses is strongly recommended in phthisis, especially in non-febrile or only slightly-feverish cases. It is said to diminish expectoration, improve appetite, and increase weight. A good formula is

℞ Creasote, 2 minims.
Com. tincture gentian, 15 minims.
Rectified spirit, 20 minims.
Water, to make 1 ounce.
M. For one or two doses.

The creasote in this mixture may be increased up to 10 or even 12 minims without increasing the other ingredients. Ringer and Sainsbury ("Hand-book of Therap.," '97).

One hundred and three cases of pulmonary tuberculosis studied. The dosage of creasote began with 5 minims three times daily, gradually increased to 25; also generous diet insisted upon, along with weighing at regular intervals. In not a single instance was appetite unfavorably influenced. Cough and expectoration steadily improved, and in most the physical signs were either the same or indicated less involvement of the lung. It is apparent that the remedy favorably influences the fever and night-sweats, and that it is superior to others in that it does not interfere with, but rather favors, the nutrition of the patient. Jacob and Nordt (Berliner Charite-Annalen, S. 159, '97).

In the treatment of phthisis the drug is well borne. Of 23 cases, 6 were in the pretubercular state, — catarrh of the apices,—and 17 had already developed tuberculosis, and all were markedly benefited. Woodbury (N. Y. Med. Jour., Sept. 4, '97).

WHOOPING-COUGH.—Both creasote and carbolic acid, by inhalation, often prove of great value in this malady, but it should not be persisted in if they induce giddiness or a sensation of intoxication.

Literature of '96 and '97.

Creasote seems especially useful when the cough is violent and prostrated, and out of all proportion to the amount of expectoration, when, indeed, the cough seems largely to depend on an excitable state of the nerves. Its effect is often rapid and complete; in fact, there are few remedies that afford, in some cases, so much and so rapid relief. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Brilliant results are had from the use of creasote, not only in phthisis, but in the sequels of whooping-cough, and the catarrh which often follows measles: two conditions which afford favorable opportunity for tuberculous infection. The usual treatment by means of expectorants is too often without results. Hock (Tex. Med. Prac., Nov., '97).

BRONCHITIS AND BRONCHIECTASIS.—Bronchitis is another malady in which the drug sometimes appears very useful.

In bronchiectasis it has been strongly recommended by Chaplin. (See BRONCHIECTASIS.)

Literature of '96 and '97.

The inhalation of steam impregnated with creasote, 10 to 20 minims to a pint of hot water (140° F.), is valuable in some cases, lessening overabundant expectoration. It will generally, also, remove the fœtor of the breath occasionally met with, and sometimes even that due to gangrenous lung. Ringer and Sainsbury ("Hand-book of Therap.," '97).

PNEUMONIA.—Because of its expectorant and stimulating qualities, recently the drug has been advantageously used as a remedy in this disorder.

Literature of '96 and '97.

In 26 cases of pneumonia, forming part of a somewhat serious epidemic, it was given on the third day. All recovered. Some treated with creasote in tincture of gentian alone; in others this was supplemented by digitalis or caffeine in small doses. The cases treated with creasote recovered more rapidly and more thoroughly than those treated in other ways. No unpleasant effects supervened from its use. Casati (Brit. Med. Jour., vol. i, '97).

G. ARCHIE STOCKWELL,
(Central Staff).

CRETINISM. See INFANTILE MYXŒDEMA.

CROTON-OIL. See TIGLII.

CROUP.

Definition and Varieties.—Confusion still exists in the classification and nomenclature of diseases of the larynx in children. This is due largely to the fact that those diseases are not well defined, but merge into each other. In young children two elements are to be detected in laryngeal affections: catarrh and spasm. Two forms of croup have, therefore, been described: the catarrhal and the spasmodic. Such a classification seems, however, unnecessary and confusing. Catarrh and spasm are present in all cases, one being predominant in one instance, the other in another. A slight degree of catarrhal inflammation is invariably present. The form of spasmodic croup marked only by spasm with no evidence whatever of catarrh, as described by some authors, is extremely rare, if it ever occurs. There is invariably present a more or less decided catarrhal element; tracheitis and bronchitis are prone to follow. In most cases, at the outset, the laryngeal spasm overshadows the catarrhal element; later, the catarrhal becomes more prominent. The disease may be mild or very severe. Many authors, therefore, describe two forms—a mild and a severe type; but these forms differ in degree rather than in kind.

Catarrhal Croup.

Symptoms.—In rare instances the onset of catarrhal croup is sudden, with no premonitory symptoms. More commonly the child has a slight cough and coryza and becomes hoarse during the afternoon and perhaps feverish in the evening. Late in the evening the cough becomes loud, dry, and hoarse, its characteristics being peculiar and distinctive. In the great majority of cases this occurs between the hours of nine and twelve. The child wakes suddenly with the characteristic cough and begins to struggle for breath. He frequently becomes alarmed at his inability to breathe, and his fright adds to the severity of the symptoms. In attacks of ordinary severity the respiration is loud and noisy; the voice is hoarse, but rarely lost; the dyspnœa is sometimes extreme and the respiration so noisy that it can be heard in an adjoining room. The loud metallic cough is very different from the stridulous, sup-

pressed cough of a well-developed case of pseudomembranous laryngitis. There is frequently extreme recession of the various thoracic spaces. The temperature is usually somewhat elevated, but rarely reaches 102°. The lips and nails frequently assume a purplish hue, but are rarely cyanotic. There is often a discharge from the nose, and the eyes are sometimes congested and watery; conditions not usually present in pseudomembranous croup. After two or three hours the symptoms usually subside. Occasionally they appear in less severe form later in the night, but, as a rule, all urgency is passed by early morning. In some instances the child is almost as well as usual during the following forenoon and shows but little evidence of the experiences of the night. The attack, however, is usually repeated during the following night, and may recur for several nights, becoming less severe with each succeeding attack. In my experience, however, this freedom from symptoms on the following day is extremely rare. More commonly the child continues to be feverish and has a troublesome cough, although it may not be croupy in character. In the damp climate of New York and vicinity an attack of croup, as a rule, is but the initial symptom of a bronchial or laryngeal catarrh, which requires several days or a week or more to run its course. Attacks more mild in form, but similar in nature, are of frequent occurrence and must be considered as simply mild attacks of croup. In other instances the attack appears to be really one of bronchitis, with a dry and croupy cough at night.

Differential Diagnosis. — In typical cases of catarrhal croup the diagnosis is evident at a glance. The sudden onset during the early hours of the night; the immediate development of extreme symptoms; the loud metallic cough; the noisy respiration; and the terror of the child, all combine to form a very characteristic clinical picture. In less typical cases, however, the diagnosis is sometimes difficult.

Catarrhal croup should be distinguished from acute catarrhal laryngitis. The latter disease may be primary, secondary to the infectious diseases, or traumatic. The lesions are found chiefly in the mucosa and lymphoid tissue of the subglottic region, and in severe cases they may be so pronounced as to cause laryngeal stenosis. This disease is frequently a complication of bronchitis. It is marked by hoarseness and a frequent, harassing, metallic cough, which always becomes worse at night and is usually aggravated by lying down. The milder and more common cases are usually seen in children between one and six years. Although extremely annoying, they are rarely dangerous or fatal. A severe type is sometimes seen, however, which may prove fatal. In this type the temperature is high; the voice is metallic and may be suppressed; laryngeal stenosis may become so great as to demand intubation. This disease is differentiated from pseudomembranous laryngitis with the greatest difficulty.

The disease may be mistaken for pseudomembranous croup, laryngismus stridulus, and even pneumonia. The presence of foreign bodies in the larynx must be excluded, as well as retropharyngeal abscess. The sudden onset, remission of symptoms, hoarseness without loss of voice, loud metallic cough, with little or no stridor, and the response to treatment usually suffice to distinguish catarrhal croup from pseudomembranous croup, with its insidious onset; slower, but more steady and unremitting, course; suppressed voice and cough, increasing

cyanosis, embarrassed expiration, and characteristic stridor. Laryngitis stridulus is a disease of early infancy. The symptoms occur in paroxysms, which are usually repeated many times a day and occur at no definite hour. They are unaccompanied by any evidences of catarrh. The disease invariably occurs in rachitic infants, and is a frequent accompaniment of tetany or general convulsions.

Croup is increased by alternations of dry and moist air. It is not always possible to obtain a view of the glottis in cases of suspected croup; therefore we have often to rely on the presence or absence of croupous exudate on the epiglottis, or on the tips of the arytenoids, for assistance in making a diagnosis. In one class of cases the cause of the stenosis lies only in the immobility and median situation of the vocal cords and the arytenoid cartilages, which are held together by false membrane in the interarytenoid space. In another class the stenosis is influenced by swelling of the mucous membrane under the glottis. Occasionally it is caused by the swelling under the glottis alone, the cartilages being normally movable; and in such cases the interarytenoid space is free from croupous exudate. Brühl and Fahr ("Diphtheria and Croup in Prussia from 1875 to 1882").

I have twice been called in consultation to find broncho-pneumonia in young children in which, when dry, difficult cough combined with an unusual degree of expiratory dyspnœa had been mistaken for croup.

Etiology.—Age is an important predisposing cause of the disease, which is most common between two and five years. It is very rare under one year and over eight. It may occur, however, at any time until adolescence, and I have seen a typical case in an adult.

Case of croup, with fatal termination, observed in a lady of 60 years, who had had several attacks of spasmodic croup at about 40 years of age. Waxham (No. Amer. Pract., Sept., '91).

Heredity is also an important predisposing cause, the disease occurring with especial frequency in some families. Enlarged tonsils and adenoid growths also predispose to croup. It is sometimes brought on, apparently, by atmospheric conditions, as it is not uncommon to see several cases at about the same time. It cannot, however, be called an epidemic disease. Exposure to cold is undoubtedly the most important and exciting cause. Excessive use of the voice in damp and cold weather is, also, a frequent cause. Indigestion will often, undoubtedly precipitate an attack in a sensitive child.

Pathology.—The lesions of catarrhal croup are found chiefly above the vocal cords and are those common to all catarrhal inflammations of the mucous surfaces. The spasmodic symptoms are due chiefly to spasm of the adductors. The disease may appear primarily in the larynx or it may extend from the nasopharynx downward or more rarely from the trachea upward.

Prognosis. — Ordinary types of catarrhal croup are never fatal. In very rare instances in which the catarrhal element predominates and is very severe, the prognosis may be grave. In other words, catarrhal croup is rarely or never fatal, while severe catarrhal laryngitis with spasm may be a dangerous disease.

Treatment. — Preventive treatment consists in the removal of all evident exciting causes, such as enlarged tonsils and adenoid growths, and in the relief of indigestion. Exercise in the open air is important, but the child must be properly clad, and all exposure should be avoided. Screaming and excessive use of the voice while at play during damp and stormy weather should be prohibited.

Anæmic and delicate children should receive proper constitutional treatment. Relief of the paroxysms may be sought by external application and medical treatment. A large, hot poultice over the throat and chest will do much to relax the spasm. A large bath-sponge saturated with water as hot as the child can bear and applied to the throat is almost as effective as a poultice and is more readily managed. Vigorous rubbing with hot, camphorated oil is also efficacious. The use of the croup-kettle and tent will sometimes prove more effectual in stubborn cases than any other measure. The steam seems to be the effective agent, but is somewhat aided by the addition of volatile substances, particularly creasote in small amount.

Among drugs, ipecac, opium, and antipyrine have proved most efficacious in my experience. If there is acute indigestion, emesis through the use of ipecac will sometimes check the attack permanently. In other cases emesis is not usually followed by complete and permanent relief. The wine of ipecac is more prompt and effective in its action than the syrup. Opium I have found the most efficacious drug in checking spasm. One full dose, adapted to the age of the child, may be given, but the ipecac may be repeated several times. It is not best to produce vomiting. During recent years I have used chiefly tablet triturates of brown mixture, the active principles of which are opium and antimony. Antipyrine is an extremely effective drug in most cases, but sometimes fails to give material relief. The best results are seen from its use when the catarrhal element is slight and the spasmodic element marked. It is a comparatively-safe drug for use among children. Two grains may be given at two years, half the dose to be repeated in one hour if necessary. My most common plan of treating the paroxysm is as follows: After evacuation of the stomach and bowels in case of indigestion or constipation, a hot sponge or poultice is applied to the throat and a full dose of antipyrine and brown mixture (mistura glycyrrhizæ comp.) is administered, the latter in the form of tablet triturate. If no relief is manifest in forty-five minutes, a second dose is given, while a few 10-drop doses of wine of ipecac are given in the interval.

Literature of '96 and '97.

Relief of the muscular spasm can be accomplished very effectually by spraying the mucous membrane of the throat with a 2-per-cent. solution of cocaine. A. O. Stimpson (Med. and Surg. Reporter, Mar. 27, '97).

Coal-oil, in doses of 15 to 30 drops on sugar, or syrup, every fifteen or thirty minutes, according to age and severity of the case, is of great value. It may also be used with turpentine and lard, on throat and chest. Casper Q. West (Med. Briet, June, '97).

On the following day cough or bronchitis is treated by the use of brown mixture given in doses indicated by the symptoms and the age of the child. They may be increased in frequency as night approaches. Antipyrine is very effective in preventing recurrence on the following nights. Two grains administered in the afternoon and again in the evening will alone frequently prevent the attack. It can, however, be given in addition to the usual cough-mixture.

Membranous Croup.

The etiology and nature of pseudo-membranous laryngitis was for years the subject of much discussion. The question has at last been settled by the bacteriologist, who has demonstrated that in the great majority of cases the disease is diphtheritic. It is equally demon-

strated, also, that a certain proportion of cases are not diphtheritic.

> Membranous croup and diphtheria are differentiated by the following points: The membrane of diphtheria is of a yellowish hue, the temperature of the body rather high, and the membrane is apt—in fact, certain—to curl up at the edges; while in membranous croup the membrane is white, does not curl at the edges, is devoid of all peculiar odor, and the temperature is rather low. Carl Seiler (Jour. of Laryngology, Aug., '90).

Of 286 cases, reported by Park and Beebe, the Klebs-Loeffler bacillus was present in 229. In the remaining 57 cases it was not present, but in 17 the examination was not satisfactory. The observations of recent years have shown that a pseudomembrane developing primarily in the larynx is almost invariably associated with the Klebs-Loeffler bacillus; that is, it is true diphtheria. Pseudomembranous inflammation of the larynx secondary to diphtheritic inflammation of the pharynx is invariably true diphtheria. A pseudomembrane developing in the larynx secondarily to the pseudomembranes which develop during the course of the infectious diseases is commonly pseudodiphtheria. Such pseudomembranes are associated with microorganisms other than the Klebs-Loeffler bacillus, generally the streptococcus.

Literature of '96-'97-'98.

> Case of pneumococcic croup in a child of 8 years, who, during an attack of influenza, manifested an erythematous angina. Laryngeal stenosis rapidly supervened and, despite the injection of Roux's antitoxin, called for tracheotomy on the evening of the same day. The wound gave issue to a false membrane of colloid appearance, which gave a pure culture of the pneumococcus. The case recovered. Seuvre (Revue Men. des Mal. de l'Enfance, Mar., '98).

Whatever the cause of the disease, whether bacillus or streptococcus, it manifests itself simply as a pseudomembranous laryngitis, stenosis being the important symptom.

Symptoms.—As the disease is so frequently diphtheritic in nature, it will be considered in detail in the section on diphtheria. Owing to the slow absorption of toxins by the laryngeal mucous membrane and the comparatively short course of the disease when confined to the larynx, the constitutional symptoms of diphtheria are slight. Hence, croup pursues practically the same course whether due to diphtheria or pseudodiphtheria. It is impossible from clinical evidence alone to determine whether the disease is true or false diphtheria. As it is true diphtheria in a very large proportion of cases, the only safe rule in practice is to consider every case of croup to be diphtheritic and to use precautions accordingly.

Pathology.—In some cases the anterior portion of the larynx alone is involved by pseudomembrane. In other cases the whole mucous membrane of the larynx is covered. In many instances the membrane does not pass below the larynx. In both true and pseudodiphtheria the membrane is but one element in the production of stenosis, œdema and swelling of the tissue underneath the pseudomembrane being an important contributing cause.

Prognosis.—Unlike pseudodiphtheria of the pharynx, pseudodiphtheria of the larynx is almost equally fatal with true diphtheria, as it causes death by mechanically obstructing respiration. Until a few years ago the age of the infant was the most important factor in prognosis, the younger the child, the more fatal being the disease.

> The younger the patient, the higher the mortality, because of the small size of the trachea and larynx and because

stenosis sooner results; the prognosis is unfavorable in the mildest cases; unfavorable symptoms are increasing debility and cyanosis, feeble and irregular pulse, and the development of bronchitis or broncho-pneumonia. Dodge (Med. and Surg. Rep., Mar. 21, '91).

Age is still a very important factor, but prompt treatment with antitoxin must be considered of far greater importance in modifying the prognosis.

Treatment.—The efficacy of the antitoxin treatment of diphtheria has been too fully established to permit of doubt or argument. It is more effective in croup than in any other form of diphtheria. An injection should be given on a clinical diagnosis without waiting for a bacteriological examination. Its early use will, in a large proportion of cases, prevent the necessity of operation. Next to the antitoxin treatment, calomel fumigations have, in my experience, proved most efficacious.

[Vaporization of calomel: A powder consisting of from 15 to 30 grains (1 to 2 grammes) of calomel is placed upon a tin plate, and heat applied until all of the powder has been vaporized; this should be done under a tent erected over the patient's bed, the curtains of which should be kept closed for ten minutes to a half-hour after each fumigation. Dense, white fumes are evolved, which are not, however, irritating to the patient, and the change in the respiratory sound, after the first burning of the calomel, is sometimes very marked. There have been no cases of salivation reported as yet in patients, but nurses and people who have to be in the room during sublimation of the calomel have, in several instances, been salivated; so due care must be exercised. J. Lewis Smith and Frederic M. Warner, Assoc. Eds., Annual, '93.]

Calomel fumigation in the treatment of croup is the most valuable means of medication in this disease possessed at present (1893), and will save a larger percentage of cases without the aid of surgery than any other method of treatment. It is also capable of doing much harm. From 10 to 20 grains may be used, according to the size of the tent in which the patient is placed, every two hours during the first day, increasing the interval to three hours on the second day, and so on, according to the progress of the disease. The patient should be left in the tent for fifteen minutes at each sitting and the flame of the spirit-lamp so regulated that the calomel all evaporates within this time. Nurses or attendants who remain much in the same room soon become ptyalized and older children occasionally show constitutional effects. In order to obtain the best results, the fumigations should be resorted to early, or before the mucous membrane becomes lined with a layer of pseudomembrane. George McNaughton and Willian Maddern (Brooklyn Med. Jour., Aug., '93).

Case of a child with true croup in which intense dyspnœa was present; before resorting to tracheotomy, inhalations of vaporized calomel, 30 grains, were resorted to, with entire success; in ten minutes the patient was quiet and comfortable and without dyspnœa. The next day the same symptoms reappeared, and like treatment was resorted to with equal success; on the fourth day the child was convalescent. Rothn (Der Kinder-Arzt., Mar., '90).

Intubation should be performed promptly when indicated.

The advantages of intubation are: it provides the necessary air without making a wound; it may be done early and without an anæsthetic; the after-treatment is simple; it is especially useful for very young infants. On the other hand, the tube may become obstructed by secretions or membrane, and food and medicine may pass through it into the lower air-passages. The following may be considered as indications for intubation: 1. Simple catarrhal stenosis. 2. Primary croup and diphtheria with laryngeal stenosis, especially in cases in which there is little possibility of proper treatment after tracheotomy. Caillé (Med. Monatschrift, Mar., '89).

The following are indications for the performance of intubation: Given a case of membranous laryngitis, with hoarseness increasing to whispering, with cough short and explosive, becoming high-pitched and prolonged, diminution of or absence of the vesicular breathing, over the lower posterior lobes of the lungs, beginning recession of the epigastrium and beginning restlessness, the call is for immediate removal of the obstruction. Note especially the character of the voice and cough; if these become progressively worse, the child's best interests will be served by delaying no longer the necessary intubation. Ground (Northwestern Lancet, Sept. 1, '91).

[There are only two impediments to the introduction of a tube of proper size in any form of acute stenosis of the larynx, viz.: entering one of the ventricles or a subglottic stenosis. Neither spasm of the glottis, nor pseudomembrane, nor œdema, when situated in or above the chink, ever offers any serious objection to the passage of a tube. J. O'Dwyer, Assoc. Ed., Annual, '92.]

Result of a collective investigation on intubation in Germany including 1445 cases intubated for the relief of croup: there were 553 recoveries, or 38 per cent. One hundred and twenty-one of the cases were secondary to measles, scarlet fever, pneumonia, etc. Secondary tracheotomy was resorted to in 250 of the cases, with only 20 recoveries, or about 7 per cent. This number proves for itself that the dangers which were formerly charged against this operation must have been greatly exaggerated.

The extraordinarily-small percentage of recoveries from these secondary tracheotomies is explained in this way: In the majority of these cases secondary tracheotomy is resorted to after the diphtheritic process has extended to the bronchi, and under these circumstances it could not accomplish any more than intubation. Ranke (Münchener med. Woch., No. 44, '93).

Individual experience in 500 cases treated by intubation: there was not a single death from pushing down membrane before the tube. When this accident, which was uncommon, did occur, the obstructing membrane was usually expelled after the withdrawal of the tube. The string is always left attached, and, if passed through a piece of fine rubber tubing, which stands a good deal of chewing, it will avoid being cut by the teeth. Bókaï (Jahrbuch für Kinderh. und physische Erziehung, June 5, '94).

The results obtained by the use of antitoxin, followed, when necessary, by intubation, have robbed one of the most deadly diseases of many of its terrors. (See Diphtheria.)

Tracheotomy for croup from December, 1886, to February, 1892, 115 times; recoveries, 39.93 per cent.; 5 cases died during the operation. Bajardi (Archivio Ital. di Ped., July, '92).

Five hundred and seventy-two tracheotomies performed in six years for croup; of these cases, 316, or 55 1/4 per cent., died. Hagedorn (Deut. Zeit. f. Chir., B. 33, H. 6, '93).

Among the other measures recommended, turpentine and hydrochlorate of ammonia hold a prominent place, but the measures already outlined are to be preferred.

Turpentine in membranous croup is of extreme value. The drug should be administered in drachm-doses, repeated every hour for from four to six doses, then suspended for six or eight hours. The membrane becomes of a muddy-yellow color, and is thrown off. If this change does not take place, recourse should be had again to the turpentine for three or four doses. S. L. McCurdy (Columbus Med. Jour., Apr., '90).

Turpentine internally in large doses recommended. In 13 cases of croup treated with drachm-doses of turpentine, there were 8 recoveries. In only one case was any disagreeable effect of the remedy observed, and that was a strangury of temporary character, after 15 drachms had been given in twenty-four hours, to a boy 4 years of age. Kellogg (Med. and Surg. Reporter, July 9, '92).

Hydrochlorate of ammonia is valuable (1) as a heart-stimulant, (2) in relieving

the spasm and œdema of the glottis, and (3) in softening the membrane. Hubbard (Med. Rec., Apr. 11, '91).

FLOYD M. CRANDALL,
New York.

CROUPOUS PNEUMONIA. See PNEUMONIA.

CUBEB.—*Cubeba officinalis* is a climbing perennial found generally throughout the East Indies, and abundant in Java, Batavia, Saranak, New Guinea, Nepane, and the Isle of France. The fruit is the part employed medicinally, and appears as partly shriveled or wrinkled berries,—owing to the fact they are gathered prior to ripening,—bearing considerable resemblance in point of size, and also in color, to black pepper and piments, but less globose and furnished with a stout stalk that is continuous with raised veins that run over the surface of the fruit and embrace it like net-work. The shell is hard, and contains a single loose seed covered with a blackish coat, but internally white and oleaginous with pungent aromatic taste and a peculiar aromatic odor that, once experienced, will never be forgotten. When reduced to powder the general tint is chocolate-brown, becoming darker with age, and an oily look and feeling. A good quality freshly ground yields about 14 per cent. of volatile oil, which, however, is readily dissipated with age; little powdered cubebs as found in shops will yield more than 4 per cent. of oil, and much of it is worthless.

Oil of cubebs is a greenish-yellow fluid possessed of a warm, camphoraceous taste and aromatic cubeb odor, soluble in alcohol, ether, and chloroform; it yields cubebic acid; cubeb-camphor, or stereopten; and cubebin.

Cubebic acid is a white, wax-like mass that, by exposure, acquires a brown hue and resin-like consistency; soluble in alcohol, ether, chloroform, and alkaline solutions.

Oleoresin cubeb is identical with the preparation formerly known as ethereal extract.

Cubeb-resin is an amorphous body soluble in alcohol and alkalies. Cubebin, at one time supposed to be identical with piperine, is a precipitate most easily obtained from the oleo-resin (ethereal extract); it is white, crystalline, inodorous, and highly bitter, especially if dissolved in alcohol. Like cubeb-camphor, it is therapeutically inert.

Preparations and Doses.—Cubeb extract, ethereal (oleoresin), 5 to 30 minims.

Cubeb extract, fluid, 10 to 60 minims.

Cubeb extract, solid, 2 to 8 grains.

Cubeb infusion (4 to 16), 1 to 2 ounces.

Cubeb-oil, 10 to 30 minims.

Cubeb, powdered, 10 to 60 grains.

Cubeb tincture, 15 to 120 minims.

Cubeb troches, 1 to 5; each should contain 3 grains of powdered cubebs with fruit-paste.

Cubebic acid, 5 to 10 grains.

Physiological Action and Therapeutics.—Cubeb is stimulant, aromatic, stomachic, diuretic, expectorant, antiseptic, and mild diaphoretic; cubebic acid is markedly antiblennorrhagic. Appetite and digestion are generally increased and improved by cubeb preparations; but too large doses or too prolonged use are apt to induce gastro-intestinal irritation, and, while exerting a laxative action, occasions a sensation of heat and discomfort in the rectum; there appears to be also a selective action for mucous membrane, more particularly that of the bladder and urethra. In very large doses (150 to 500 grains of powder) considerable febrile action is observed, along with griping, drastic purging, headache, nettle-like eruption, and, rarely, paralysis.

Cubeb, like other peppers, readily enters into the circulation and increases the force and frequency of the heart's action. It is absorbed and eliminated with considerable rapidity, chiefly by the kidneys, but also through the skin and bronchial mucous membrane.

Catarrhal Disorders.—In maladies of a catarrhal character, such as gonorrhœa, gleet, leucorrhœa, vaginitis, infantile enuresis, chronic inflammation of bladder and prostate, chronic bronchitis and other pulmonary affections, it is of great value, and much of the ill repute that accrues to the drug is due to the dispensing of inert preparations and erroneous methods of application. As an example, the powder of cubeb is often recommended in such disorders as hay fever, chronic rhinitis, etc., in which local hyperæsthesia is an active factor. Such a use of the remedy serves only to discredit it.

Considerable benefit sometimes follows its use, however, when cubeb-leaves are smoked in cigarettes in disorders of the respiratory tract characterized by free secretion. A spray of lanolin more or less strongly charged with cubeb, according to the intensity of the trouble present, is also of marked value in catarrhal inflammations of the nasal and pharyngeal cavities. The troches of cubeb, 1 bean, slowly dissolved in the mouth every two hours, serve to maintain the beneficial action of the remedy.

CURARA. — This substance—known also as curare, woorari, ourari, urari, woorara, wourali, and ourali, though it has been before the medical profession for more than half a century—is practically unknown as to its source and composition. There is considerable evidence to show that it is derived in part from two or more trees of the strychnine group, from the *Menispermum cocculus* (*Cocculus Indicus*), and various unknown plants. It comes chiefly from the valley of the Orinoco,—Brazil, British and French Guiana, Venezuela, and Colombia,—where it serves certain savage tribes as an arrow-poison. It is by no means a stable or uniform substance; some appear to have mingled with it the poisonous principle of Jatropha (*Manihot utilissima*), known as *obi* or *obiah* poison in the West Indies, while that from Colombia is of lighter color, appearing as a yellowish-brown, amorphous, deliquescent powder. Brazilian and Guianian curare is a blackish, intensely bitter, hygroscopic mass of resinous appearance. Both are soluble in dilute alcohol to the amount of 70 per cent. and in the water to 75 or 85 per cent., but insoluble in ether. Two alkaloids have been segregated known as "curarine" and "curine."

> The Indians of the Orinoco prepare two kinds of curara: one a relatively-mild poison used in the chase, its chief source being *Strychnos gubleri*; the other much stronger, a war poison, from the *S. toxifera*. Planchon (Provincial Med. Jour., July, '88).

Preparations and Doses.—Curara, $^1/_{30}$ to $^1/_2$ grain.

Curarine, $^1/_{200}$ to $^1/_{50}$ grain.

Curarine sulphate, $^1/_{200}$ to $^1/_{100}$ grain.

Curine, uncertain.

Physiological Action.—Neither curara nor its alkaloids are ever employed except endermically (rarely) or hypodermically, since it is held that all are decomposed in the stomach and rendered practically inert. The latter is not true, however; but the process of absorption is extremely slow; but when employed subcutaneously it is rapidly absorbed. Elimination is rapid, chiefly by the kidneys, causing sugar to appear in the urine, and partly with the fæces; per-

spiration, saliva, nasal mucus, and tears, though greatly increased, do not seem to share in the eliminative process.

It is not absorbed by intact integuments, but is absorbed (though with difficulty) by mucous membrane. When introduced into the system and brought in contact with the systemic tissues, the drug develops identical biological effects in dogs, cats, rabbits, pigeons, amphibians, batrachians, reptiles, fishes, crustaceans, insects, and amœbæ. According to the duration of its contact with various organs and tissues, curara may paralyze either the central nervous system or terminations of motor nerves of any muscular structure (including the heart) and of the vagi; this least rapidly in dogs and rabbits. In mammals generally it causes death by paralyzing the respiratory centres, but not the peripheral respiratory nerves. The proximate cause of the biological effects of curara is, probably, constituted by the drug inducing some alterations in the protoplasm of both nervous and muscular structures, though to a different extent, and not simultaneously. Dogiel and Nikolski (Medit. Oboz., No. 3, '90; Med. Chron., June, '90).

Curarine paralyzes the motor nerve-endings, but has no effect on sensory nerves. The irregularity and the early depression of the reflexes are not due to an action on the spinal cord or the sensory nerves, but to an inhibitory influence exercised upon the cord by a stimulation of the higher centres. The alkaloid likewise exerts a tetanic action on the cord, but the reason why it does not induce tetanic spasm, in the great majority of cases, when given hypodermically is because the circulatory changes produced are such as to prevent the drug from having access to the cord, and because these changes of themselves produce spinal paralysis. With larger doses there is dilatation of the abdominal vessels, and hence accumulation of blood, little or nothing of this fluid entering the empty ventricle, notwithstanding that the heart may continue to beat. Curarine causes an almost immediate fall of blood-pressure in mammals; it occurs even after section of vagi, after a paralyzing dose of atropine, after division of all the cardiac nerves, after section of the spinal cord, and after paralysis of the central reflexes by urethane. The cause, therefore, of the fall of pressure must be due to a direct action upon the peripheral nerves or upon the muscles of the blood-vessel walls. It was found, however, that when an injection of barium was made into the circulation a rise of pressure was produced, while, on the other hand, no such action was effected by stimulation of the peripheral nerves. Again, the vasomotor centre was found to be active by the appearance of the "Traube-Hering" curves during the cessation of respiration by the action of the drug. This evidently proves that curarine causes a fall of pressure solely by a paralyzing influence exercised on the vasomotor nerves. The inhibition of the vagi is destroyed by curarine easily in cats, less so in dogs, and with difficulty in rabbits. Small doses in a healthy rabbit caused the appearance of albumin, blood-pigment, and blood in urine.

An infusion of the bark of the *Strychnos toxifera* caused the same effects as curara and curarine.

Curine has no apparent effect on motor nerves, but acts on the heart like veratrine or drugs of the digitalis group. Tillie (Med. Chron., Mar., '91).

In poisoning by curara muscular power is notably diminished. Gréhant and Quinquaud (La Sem. Méd., Apr. 22, '91).

The action of the drug on muscle-tissue is a factor in the general paralysis induced. According to Reichert, doses insufficient to cause motor paralysis may increase the temperature, or primarily increase and secondarily diminish it. The use of quantities just sufficient to abolish voluntary motion act differently in different animals: the temperature from the first may be increased or decreased, or primarily increased and secondarily decreased, or primarily diminished and accordingly increased; generally there occurs a notable diminution or

a decided increase, the former effect predominating.

A variety of curara from Colombia causes absolute paralysis of the muscle of the heart, the respiration continuing; and absolute paralysis and rigidity of the skeletal muscles at a much earlier period than happens in the case of an animal whose circulation has been artificially arrested; also exemption of the motor nerves from paralysis until after death and until the muscles show signs of poisoning. In an experiment upon a rabbit the effects produced were markedly different from those caused by ordinary curara. With the new drug the motor weakness only appeared near death; but there was marked action on the heart, as well as an early total paralysis of muscles and onset of rigidity. Tillie (Jour. Anat. and Phys., Oct., '93).

Literature of '96 and '97.

Medicinal doses render the pulse more full and exceedingly rapid,—there is marked dilatation of the blood-vessels of the skin and the various glands,—and the blood-pressure, though little affected by small doses, is decidedly lowered by large ones. The action on the circulation is due to diminished inhibition on the heart, owing to paralysis of the ends of the vagi, while the accelerator nerves are stimulated. It elevates temperature.

Immoderate doses cause great muscular weakness and paralysis of all the voluntary muscles. The ends of the motor and sensory nerves are paralyzed, the former being soonest affected. Beyond a slightly-diminished contractility, the voluntary muscles are but little influenced. The spinal cord may be paralyzed by toxic doses, although the brain-centres remain unaffected until carbonic-acid narcosis sets in. It is likewise a powerful respiratory depressant, paralyzing the ends of the motor nerves distributed to the respiratory muscles; if the doses are lethal, the paralysis becomes central, finally producing death by its action on the respiratory muscles. Butler ("Text-book of Mat. Med., Ther., and Phar.," '96).

Poisoning by Curara.—In poisoning the movements of the heart are greatly accelerated, the pulse weak and dicrotic, the temperature high, respiration depressed; extreme muscular weakness ensues, with inco-ordination of movements; urine is saccharine; paralysis of extremities and respiratory muscles supervene, and death ensues from the latter cause.

Treatment of Curara Poisoning.—The treatment of the poisoning consists chiefly of artificial respiration and the employment of tetanizing agents, such as strychnine and picrotoxin. Alcoholic stimulants may be indicated. Caffeine, atropine, and chloral are sometimes of benefit.

Therapeutics.—Curara is more employed in the physiological laboratory than as a medicament pure and simple, and study of the drug on therapeutic lines has, in a measure, been inhibited because of its unreliable composition; so true is this latter that the caution is generally given that before any one sample is employed in the human subject its strength should first be tested on one of the lower animals. Merck, however, puts out a reliable article: one that is carefully tested ere it is offered for therapeutic purposes. It is a powerful remedy for good when employed in convulsive diseases, such as hydrophobia, traumatic tetanus, and epilepsy, and sometimes yields good results in paralysis agitans, locomotor ataxy, nervous debility, and the dyspepsia of emphysema.

Case of a boy, aged 16 years, who had suffered with epilepsy since infancy and in whom the attacks occurred at intervals of a few minutes. After all other remedial measures had been exhausted $^1/_{10}$ grain of curara was injected hypodermically, when the attacks recurred at intervals of hours instead of minutes. After six injections of curara, at five-day intervals, in doses of $^1/_{10}$ or $^1/_9$ grain, complete relief was had; after several

months no return of the epilepsy was experienced. Dobrorarow (La Sem. Méd., June, '94).

It would seem, from Tillie's (*ante*) researches, that a preparation from the bark of *Strychnos toxifera* would afford a remedy of the same scope as curara, and one, moreover, that would be uniform in strength. Used judiciously, it would probably be a valuable addition to the list of antispasmodics, one especially available in neuropathies.

G. Archie Stockwell,
(Central Staff).

CURVATURE OF SPINE. See Spine.

CUSSO. See Kusso.

CYNANCHE TONSILLARIS. See Tonsils.

CYST. See Tumors.

CYSTITIS.—Lat., from Gr., κύστις, the bladder, and *itis*, inflammation.

Definition.—Inflammation of the urinary bladder, involving one or more of its four coats: mucous, submucous, muscular, and serous.

Varieties.—Cystitis has been divided into a large number of varieties, the subdivisions being based upon the many etiological and pathological features of the disease. A further classification of this disease into the acute, the subacute, and the chronic is dependent upon the intensity of the symptoms and the length of time of their existence and is utilized in this article.

Symptoms.—In acute cystitis the commencement differs somewhat according to the determining cause. When traumatic, it may be ushered in with rigors or marked chill succeeded by burning pain in the bladder and glans penis, etc. In other instances, and when from other causes, it is announced by a feeling of uneasiness, which is located in the perineum. There is increased frequency of urination and spasmodic pain during micturition and more or less fever. Usually the fever is absent, but, in the severe forms, there is moderate fever and sometimes, in the pseudomembranous variety, quite high fever. Usually the temperature in cases of fever range from 100° to 102° F., though it may be higher. These constitute the ordinary symptoms. Pressure upon the bladder is intolerable. The urine may be blood-tinged throughout the attack, but more usually is replaced soon by pus, and becomes ammoniacal. Acute retention is common. If complete retention ensues, the bladder gradually becomes more and more distended and can be felt as a rounded tumor, giving a dull sound on percussion, rising higher and higher above the pubes. The tenesmus vesicæ, or the feeling that the patient has not emptied the bladder after the viscus has been emptied, may occasionally be communicated to the rectum; and, in point of fact, all of the pelvic organs may participate in the painful and distressing sensation.

The frequent desire to pass water varies in intensity. It may be every few moments or almost incessant; several times an hour or once in a couple of hours.

The constitutional disturbance, when the disease is of grave form, is very marked, as indicated by a frequent pulse, thirst, headache, and nausea, with great restlessness and mental anxiety. When cystitis progresses toward a fatal termination, portions of the walls of the bladder may suppurate or even slough, and may be discharged in stringy fragments; the urine emits a vile odor, from the products of its own decomposition and the gases resulting from the dead mucous

and submucous tissue which it contains; the patient is harassed with hiccough; the pulse becomes very small and frequent, the tongue dry and hard, streaked with a dark coat; the strength rapidly fails; the secretion of the kidneys diminishes or is entirely suspended; the countenance becomes sunken and cadaverous, the extremities cold, the surface moistened with perspiration, from which emanates the odor of urine, and the patient at last passes into a state of profound stupor, from which he never awakens. (D. Hayes Agnew.)

In chronic cystitis the symptoms are mainly those of the acute variety, but in a milder degree. Only slight fever is present, but the combination of pain and other distress rapidly undermines the general health.

Literature of '96 and '97.

Case of cystitis without symptoms. The urine was pale, had a specific gravity of 1018, and contained much albumin and some leucocytes, with epithelial and granular casts. There was no uræmia. At the autopsy was found chronic cystitis, especially around the trigone. Martha Wollstein (Med. Rec., Jan. 23, '97).

The urine is turbid, alkaline, and contains much mucus and pus, which forms a tenacious clot at the bottom of the retaining vessel. While the urine is usually alkaline, it occasionally is faintly acid, but, if so, promptly becomes alkaline, due to the formation of ammonium carbonate out of the normal urea, the probable result of the operation of bacteria.

Literature of '96 and '97.

There seems very little doubt that we have to recognize the existence of two distinct types of cystitis: one associated with acid and the other with alkaline urine. In the latter some of the organisms capable of decomposing urea and liberating ammonia are present, *e.g.*, the diplococcus ureæ liquefaciens, the proteus Hauser, the bacillus pyocyaneus, etc., with or without the bacillus coli communis; in the acid forms of cystitis the latter organism is alone present. The former type has long been recognized and its characters noted; but practitioners are not so frequently on the lookout for cystitis with acid urine. Melchior (Centralb. f. d. Krankh. d. Harn- u. Sexual-organe, May, '97).

The greater alkalinity thus resulting reacts upon the pus and converts it into a glairy matter similar to mucus, thus further increasing the difficulties of urination. (Tyson.)

Diagnosis.—This is usually easy. Yet there sometimes occur mild forms which it is difficult to differentiate from mild degrees of interstitial nephritis, while it not very rarely happens that these two conditions are associated. In contracted kidney there are sometimes many leucocytes also. The presence of hyaline casts, even when scanty, points to nephritis, while hypertrophy of the left ventricle and increased arterial tension settle the question. Still more emphatic is the diagnosis if there be retinitis albuminurica (Tyson). According to the same authority, the question whether there is pyelitis, separate or associated with cystitis, is still more difficult to determine. Catheterism of the ureter by the method of Howard A. Kelly, if a possible procedure in the given case, would, of course, clear up all doubt. Tyson places most reliance on the symptom of tenderness in the region of the kidney.

Usually the symptoms of the diseases under discussion leave scarcely any room for doubt; the sense of uneasiness in the neighborhood of the bladder, the frequent desire to empty the bladder, and the thick, purulent urine, taken in con-

junction with microscopical examinations, will render the diagnosis certain. It is very important to ascertain whether the cystitis is idiopathic or the result of disease of the urethra, prostate, etc., and especially whether a foreign body, such as a calculus, is present in the bladder. It is also important to differentiate spasm of the bladder, which is also attended by pain and frequent micturition; but the quality and the daily quantity of the urine passed remain normal.

Literature of '96 and '97.

There is a series of diseases with bladder manifestations in which no pathological condition exists in the bladder usually diagnosed as cystitis. The bladder symptoms in such are the result of nervous reflexes, principally from an affected posterior urethra, but they may also come from the anterior urethra, from the ureter, and even from the kidney. The diagnosis is often extremely difficult and depends finally on careful local examination. In cases of false cystitis the symptoms are always aggravated by intravesical medication. Guépin and Grandcourt (Med. Rec., Sept. 18, '97).

In polyuria also the urine is voided frequently, but without any pain or purulent sediment. (Lebert.)

Etiology.—Men are more liable than women to vesical catarrh. Traumatism is a frequent cause; injuries, such as blows and pelvic fractures, more particularly of the pubic bone, though both are rather rare conditions. Operations of lithotomy, lithotrity, catheterism, injections; pressure, as in prolonged and instrumental labors, in which class of cases gangrene of the walls of the viscus has been known to ensue, followed by a large vesico-vaginal fistula. Mechanical irritation of foreign substances in the bladder, such as calculi; the poisonous effect of certain drugs, as the chemical action of cantharides and some of the mineral poisons; the action of the urine itself, retained and decomposed, as in stricture and in prostatic enlargement; inflammations of neighboring parts, as the kidneys, prostate, rectum, urethra, and, when so developed, it is in consequence of a pre-existing gonorrhœa, a prostatitis, or the presence of a stricture,—urethral or rectal,—etc.; acute cystitis sometimes develops secondarily in the course of the infectious diseases.

Two cases of acute cystitis in which a rheumatic origin seemed undeniable, an acute articular rheumatism following its regular course before, during, and after the vesical affection. Davezac (Jour. de Méd. de Bordeaux, Nov. 1, '94).

Literature of '96 and '97.

Frequency of cystitis in the course of infectious diseases attacking nursing children. Thirty cases observed all under one year of age; all girls, suffering from broncho-pneumonia, acute gastro-enteritis, meningitis, etc., which nearly always ended fatally. The etiology is nearly always dependent upon retention, the result of the grave general disease. Finkelstein (Revue Prat. d'Obstet. et de Gynéc., July, '97).

Regarding the bacterial origin of cystitis, James Tyson states that the question of whether the obstructive causes enumerated are of themselves sufficient, or whether they may simply supply the conditions favorable to the operation of bacteria, may be considered unsettled at the present day. J. W. White and Edward Martin, on the other hand, hold that all cases of cystitis are undoubtedly due to the presence of pathogenic organisms. Among the organisms capable of producing inflammation may be mentioned the streptococcus pyogenes, staphylococcus pyogenes aureus, diplococcus, bacterium coli commune, tubercle bacilli, etc.

Cases in which irritation of the bladder, cervical cystitis, and even hæmaturia followed the use of large doses of bicarbonate of soda in dyspepsia. Cystitis might easily be avoided if, before prescribing the alkalies, the acidity of the urine were measured. When the urine is very acid, bicarbonate of soda cannot be hurtful, while if it be but slightly acid an intensive alkaline treatment might greatly increase the alkalinity of the urine to such an extent as to allow development of microbes contained in the bladder. Mathieu (Comptes-rendus Hebd. des Séances et Mém. de la Soc. de Biol., Mar. 22, '95).

Case of gonorrhœal cystitis in which the mucous membrane of the bladder showed, on microscopical examination, gonococci in both epithelium and connective tissue. In the submucous connective tissue the capillaries and blood-vessels were found to be filled with gonococci, partly involved, partly characteristically tinged. Wertheim (Deutsche med.-Zeit., p. 1133, '95).

Six cases of cystitis examined and the streptococcus pyogenes found once and bacilli belonging to the coli-commune group five times. The latter were pathogenic for mice, guinea-pigs, and rabbits. In one case the urine was examined ten times and the bacillus found in a pure culture each time. Huber (Corres. f. Schweizer Aerzt., Oct. 1, '93).

Literature of '96-'97-'98.

Cystitis may be caused by colon bacilli in little girls with first vulvo-vaginitis, then accidentally produced intestinal infection, and finally the cystitis. Hutinel (Revue Inter. de Méd. et de Chir., vol. vii, No. 23, '97).

The bacterium coli is one of the most common germs found in cystitis. It may enter the bladder by passing through the urethra, or from the neighborhood through the vesical wall; but it may also enter the blood-vessels and pass out again through the kidneys when the latter are in a morbid state. Thus this bacterium may be a cause of cystitis when predisposing conditions exist. Of 37 cases of cystitis examined, the colon bacillus was found in 13 (12 times solitary); diplococcus ureæ liquefaciens 11 times (9 times solitary); proteus Hauser 5 times (3 times solitary), and staphylococcus pyogenes 4 times (3 times solitary). M. Melchior (Ugeskrift for Läger, '97).

Analysis of forty-six cases. Conclusion that cystitis (with certain rare exceptions of chemical or toxic origin) is always due to micro-organisms, the bacterium coli commune being the most common. The mucosa of the bladder, however, must previously be in a condition favorable to infection. Karger (Centralb. f. Gynäk., No. 2, '98).

Pathology.—The changes which are produced by cystitis consist in increased vascularity of the mucous membrane; its light-red color being exchanged for one of a dark-crimson hue throughout, deepening to purple or even black about the neck of the bladder; or the mucous membrane may be ecchymosed, and in places necrotic, and the muscular layer may be exposed. Hæmorrhages may occur from bursting veins or separating sloughs; or perforation may occur into the surrounding tissues or into the peritoneal cavity. Peritonitis may arise without actual perforation (John B. Roberts).

In the more chronic cases the epithelium desquamates vary rapidly; mucus at first and then pus is poured out in large quantity. The urine soon becomes alkaline and is putrescent. Blood is frequently present. Decomposition precipitates the salts of the urine and calculi are found in the bladder or a calcareous deposit occurs upon the walls of that viscus. When the disease has been of long duration the muscular wall becomes either hypertrophied and contracted, or its fasciculi become irregularly stretched apart while the mucous membrane sinks into the intervals, giving rise to the condition known as sacculated, or ribbed, bladder. These depressions or sacs may become large and retain decomposed

urine, act as receptacles for calculi, or perforate and give rise to peritonitis or perivesical abscess. The ureters and kidneys soon become involved, and add materially to the serious nature of the case.

Prognosis.—The prognosis will depend on the ability of the surgeon to remove the cause and on the duration of the disease. Ordinary acute cystitis, when uncomplicated, is not attended by any great danger. Protracted cases of acute vesical catarrh do occur and may run a very chronic course. The chronic form is to be regarded as troublesome and very intractable, rather than dangerous to life. In young and middle-aged patients, and in those of good constitution, the prognosis is more hopeful and the treatment is more effectual than in those who are advanced in years or enfeebled by disease.

Treatment.—In the acute form the patient should be ordered to bed at once. The diet should be light and unstimulating: milk, broths, eggs, etc. Stimulants are to be avoided. The bowels should be regulated by the administration of a saline. In point of fact, all such cases are better for the use of some drug as the citrate of magnesia, epsom salt, Hunyadi water, etc., employed to the point of free purgation. Tyson claims that leeches should be applied to the perineum more frequently than they are. If the urine is acid, it should be rendered neutral by alkaline drinks. For this purpose H. C. Bloom recommends Vichy water containing much soda. In most cases the urine is alkaline, though not as frequently in the acute cases as in those that are chronic. The best remedy for neutralizing an alkaline urine is benzoic acid, either administered in solution well diluted with water, or in capsules containing 5 grains of the drug, administering every three hours until the desired result is obtained. Considerable water should be taken after each capsule. When there is much ammoniacal decomposition, salol, in capsules of 5 grains each, given every two hours until the urine is rendered acid, is a valuable remedy. Boric acid, in 10- or 20-grain doses is often efficacious. A weak nitrate-of-silver solution is recommended by some surgeons.

Literature of '96-'97-'98.

When the urethro-vesical tract is in such a condition that interference can be tolerated, irrigations with a nitrate-of-silver solution, beginning with a strength of 1 to 16,000 and increasing gradually, are effective. This is allowed to flow into the bladder through the anterior urethra by the force of gravity from a fountain-syringe, the height of the receptacle being sufficient to produce enough pressure to overcome the resistance of the cut-off muscle. So soon as the patient feels the tension of the fluid in the bladder the flow is discontinued and the patient is directed to stand and empty the viscus. These irrigations may be given every day, or every second day, as the patient's symptoms may indicate. Ramon Guitéras (N. Y. Med. Jour., Mar. 19, '98).

In acute cystitis a teaspoonful of the following mixture in water every three hours is of value:—

℞ Fluid extract of buchu, 1 ounce.
Citrate of potassium, 3 drachms.
Sweet spirit of nitre, 4 drachms.
Syrup of lemon, to make 3 ounces.
—M.

(Med. News, Sept. 18, '97).

If it be uncomplicated, complete and rapid recovery may be brought about by injecting the bladder with silver nitrate, 1 to 2 per cent. In recent cases one injection may suffice; in cases of long standing the irrigation may require to be repeated during a period of one to two weeks or longer. A sufficient amount of the solution must be introduced to distend the bladder (usually about eighty cubic centimetres); after four or five minutes it is allowed to escape; the bladder is then rinsed out three times with sterilized water before

the catheter is withdrawn, otherwise the silver nitrate comes into contact with the urethra. If the procedure is followed by painful contractions of the bladder (which is unusual), a morphine suppository should be inserted into the bowel. Rovsing (Ann. d. Mal. d. Org. Génito-Urin., Oct. to Dec., '97).

In cases where the inflammation is too acute to tolerate irrigations, instillations of nitrate of silver are of great value. They should be given with the Ultzmann or the Otis syringe, beginning with a strength of a grain to the ounce and increasing the strength to ten grains if necessary. From 5 to 20 drops of such a solution may be employed at one time.

Literature of '96 and '97.

Girl of 19, under treatment for gonorrhœa which had distinctly involved the uterine mucous membrane, began to complain of pain during micturition. On examining the urine gonococci were detected in pure culture. Through the cystoscope the vesical mucosa appeared very vascular, with superficial loss of substance at certain points. The cystitis was cured by washing out the bladder with warm boric lotion and injection of a 1-per-cent. solution of nitrate of silver. Lindholm (Cent. f. Gyn., No. 21, '97).

Irrigations and injections of permanganate of potash in $^1/_{12}$- to $^1/_4$-per-cent. solution is a most excellent remedy. In employing vesical irrigation it is important to observe the strictest attention to the cleanliness of all instruments used. Large injections should not be used. Better an ounce or so at a time frequently repeated, until the washings come away perfectly clear. The temperature of the solution should be about 100° to 105° F. When there are local causes for reflex irritability, as hæmorrhoids, varicocele, phimosis, adherent prepuce, or a narrow meatus, appropriate surgical treatment should be resorted to. Urethral causes of irritability of the bladder or of partial retention of the urine, such as stricture of either large or small calibre should be promptly attended to. (White and Martin.)

In chronic cystitis, whatever be its origin, the treatment of the inflammation of the bladder should be by both local and internal medication until it is in a condition that will permit of more radical measures.

Literature of '96 and '97.

Every patient must be carefully nourished. In prescribing internal remedies due regard must be paid to their effect upon the appetite and digestive functions. Creasote must be given in very small doses, and over a long period. Should definite improvement not result from general treatment, or the symptoms be such as to forbid delay, recourse must be had to local applications. The drug which yields the best results is corrosive sublimate, in aqueous solution, beginning with a dilution of 1 to 10,000 and gradually increasing the strength to 1 to 5000; this to be distilled in small quantity every day or every second day. Guaiacol, although very soothing to the sensitive mucous membrane, is distinctly inferior to sublimate.

Operative interference is indicated when the symptoms of pain and frequency are very severe, and when no improvement has resulted from general and local treatment: distinctly, therefore, a more serious group of cases. Curetting the bladder, through the perineum in the male and through the urethra in the female, followed by thorough drainage, has yielded the best results. The perineal route is preferred, because it is easier, because it gives readier access to the usual situation of tubercle in the bladder, and because the drainage it affords is the best. The only advantage of the suprapubic method is that of allowing one to see the seat and extent of the lesion. Banzet (Ann. d. Mal. d. Org. Génito-Urin., June, '97).

In women the lesions of cystitis are, in reality, more frequently localized around the neck of the uterus and of

the trigonum, and for a long time they are rather superficial. It is only in extreme cases that the condition of interstitial cystitis, which seems to be beyond therapeutic resources, becomes established. In such cases amelioration is very distinct after vesical curetting. The operation is very simple and preceded by thorough lavage of the bladder. For this a solution of boric acid is used to which 1 per cent. of a solution of corrosive sublimate of the strength of 1 to 1000 without alcohol is added.

According to Guyon, this intervention does not completely cure the cystitis, but it renders the disease more amenable to other methods of topical treatment which before could not be tolerated.

Treatment may be summed up as follows: Treatment of the uterus and its adnexa and general treatment. Local treatment of cystitis, although easy in light cases, becomes insufficient in pronounced cases. Surgical treatment becomes necessary in cases in which the pain is intense. Cystotomy, particularly colpocystotomy, should be reserved for very serious cases. Very often recovery or a step toward recovery, by means of local topical treatment, may be obtained by curretting the bladder through the urethra. This operation is simple and easy; it does not require any complemental operation, and it gives excellent results. M. G. Camero (Gaz. Heb. de Méd. et de Chir., Sept., '97).

The next step is to remove the cause of the trouble, if discoverable. Strictures of the urethra must be dilated, for eign bodies must be removed, retention of the urine from enlargement of the prostate or paralysis, etc., must be treated by the regular use of the catheter and then by such operative interference as is deemed best suited to the individual case.

A soft catheter should be used and as often as the viscus will allow without adding to the irritability present, twice or three times in the twenty-four hours not being too frequent.

A large percentage of female patients suffering with subacute vesical symptoms —as painful micturition, bearing-down sensation, and a feeling that the bladder is not emptied after micturition—can be readily relieved by dilatation of the urethra. The greatest amount of practical good that has been obtained in bladder troubles is by the use of the cystoscope. J. M. Baldy (Phila. Polyclinic, No. 18, p. 100, '95).

The best internal remedies,—*i.e.*, those usually praised—are benzoic acid, about 30 grains a day in divided doses; benzoate of sodium, 10 grains four times a day; salol, in a similar dosage; and urotropin, 7 1/2 grains three or four times a day, well diluted with water.

If there is residual urine in the bladder, it is only a question of time as to when that urine will decompose and give rise to cystitis. Women seldom completely empty the bladder while lying perfectly flat on the back. Hence, when, on account of illness, they are placed on the back sufficiently long, cystitis may occur. Cases cited in which cystitis supervened after an interval of ten days, and in another as soon as three days after operation. In appropriate cases, the recumbent posture should be changed to the sitting posture when at all possible. To correct the offensive odor, salol and betol are useful. A dose of 5 grains, three times daily, of betol, will, as a rule, completely correct the odor in twenty-four to thirty-six hours. W. H. Bennett (Clinical Jour., Mar. 27, '95).

Cantharidin tried in 56 cases of cystitis. Formula used: Cantharidin, 1/500 grain; alcohol, as solvent, 15 minims; distilled water, enough to make 3 1/4 fluidounces. A teaspoonful of this was given three or four times a day; larger doses did not succeed if this failed. Results: In but 5 cases there was no improvement; in 19 its action was slight, the strangury alone being improved or the urine clearing without the cure being complete; 32 cases were completely cured, often with surprising quickness. In 3 cases of gonorrhœal cystitis can-

tharidin succeeded where sandal-wood oil failed. Freudenberg (Wiener klin. Woch., June 6, '95).

Literature of '96 and '97.

In gonorrhœal cystitis, rest in bed, avoidance of all local irritations, administration of morphine, codeine rectal suppositories, or of extract of hyoscyamus, use of local warm baths; forbidding of spices, alcohol, and carbonated waters, and the giving of laxatives. Priapism can be avoided by the bromides, with camphor or cannabis Indica. For the cystitis itself, salol, in three doses of 15 grains each, sodium salicylate, or sodium benzoate are useful. If the digestion is excellent, oil of santal, cubeb, kava-kava, balsam of copaiba, balsam of Peru, and oil of turpentine may be employed. Of importance is the use of infusions, as of uva ursi, quite likely on account of their diluting the urine. M. Harovitz (Centralb. f. d. Gesammte Therapie, H. 2, S. 65, '97).

The patient should be advised to drink freely of water and should be careful regarding diet. Locally the bladder should be washed out once or twice a day with a solution of permanganate of potash $^1/_{4000}$ to $^1/_{5000}$; silver nitrate in a similar strength; boric acid, 10 grains to the ounce; bichloride of mercury, $^1/_{4000}$ to $^1/_{500}$.

Literature of '96 and '97.

Three cases of tubercular cystitis treated which seemed incurable by injection of sterilized air. The air is allowed to remain in the bladder for a period of five minutes, when it is allowed to escape by means of the sound. Should pain be produced by this method the operation is not resorted to again for two or three days. Ramond (Ther. Gaz., July 15, '97).

In cystitis due to enlarged prostate the question of operation has to be considered, and includes such procedures as castration (White's operation); resection of a portion of the vas deferens; enucleation of the prostate; incisions of the prostate (Bottini's method), etc.

Anodynes are indispensable in many cases of cystitis to relieve the frequent desire to urinate and the extreme pain the patient suffers. They are best given per rectum and in the form of opium or its alkaloids. Many cases demanding operation for the relief of the distressing symptoms inevitably associated with chronic inflammation of the bladder are only relieved by such measures as a suprapubic cystotomy or a perineal section.

[The severe pain attending the passage of urine is often relieved by the use of 5-grain doses of chloride of ammonium every three hours, especially if litmus-paper show the urine to be acid. Ed.]

Lewis H. Adler, Jr.,
Philadelphia.

D

DACRYOADENITIS. See LACRYMAL GLAND.

DACRYOCYSTITIS. See LACRYMAL GLAND.

DANDRUFF. See PITYRIASIS.

DEAF-MUTISM.

Definition. — Deaf-mutism, strictly speaking, signifies the abnormality which is characterized by the co-existence of deafness and dumbness. Various circumstances, which will be treated of in the following pages, necessitate, however, a more limited definition. Deaf-mutism may, therefore, be defined as a pathological condition dependent upon an anomaly of the auditory organs, either congenital or acquired in early childhood, causing so considerable a diminution of the power of hearing as to prevent the acquisition of speech, or—should speech have been acquired before the occurrence of the loss of hearing—as to prevent its preservation by the aid of hearing alone. Persons exhibiting this pathological condition are described as deaf-mutes, even when speech has been acquired by a special system of instruction.

Theoretically, deaf-mutism is an ill-defined condition, which cannot be distinctly separated from other conditions related to it. This is a natural consequence of its being a pathological term founded, not only upon a symptom, deafness, but also upon the intensity of that symptom and the period of its occurrence. There is, also, an apparent contradiction in the fact that deaf-mutes include, not only those who cannot, but, also, those who can, hear or speak. Practically, however, there is seldom any difficulty in determining whether a person is or is not a deaf-mute, just as it is, also, as a rule, easy to recognize deaf-mutism, when the subject in question has passed the first years of infancy. The reason is that the acquisition and preservation of speech in childhood is so dependent upon hearing that, as soon as the latter sinks below a certain degree, the former cannot be developed, or is lost, and this secondary dumbness does not easily escape observation. Occasionally, it may be difficult to decide whether a child should be described as a deaf-mute or as merely deficient in hearing and speaking. Such cases must be decided by purely practical considerations, and it may not be out of the way to observe that in Denmark—one of the few countries where the education of deaf-mutes is compulsory—all children are considered deaf-mutes who cannot, owing to their deficient hearing, take part in the instruction given to normal children.

Classification. — Deaf-mutism can be classified (1) either according to the degree of its symptoms, or (2) according to its etiology. In the first case a distinction must be made according as the deafness or dumbness is absolute or not. *True deaf-mutism* may be described as being the state in which the hearing is positively *nil*, and in which there is no power of speech, unless it be acquired by a special method of instruction. Persons with this form of deafness may be designated as true deaf-mutes. Those who have some slight power of hearing or some power of speech (either because the hearing is not totally absent or because the deafness occurred after speech had been acquired) may be described as *semi-mutes*.

Etiologically, deaf-mutism has been

further divided into *endemic deaf-mutism* (*i.e.*, that which attaches to certain districts and their natural conditions) and *sporadic deaf-mutism* (which is the result of certain accidental causes).

The most general classification of deaf-mutism is that which discriminates between the deaf-mutism resulting from *congenital* pathological changes of the organs of hearing and that resulting from such changes which are *acquired* after birth.

We have reason to surmise, according to modern statistics, that at least half the cases of deaf-mutism are caused by acquired deafness. The relative proportion must, however, vary very much in different places and at different periods, epidemics of certain infectious diseases, for instance, increasing the absolute number of deaf-mutes with acquired deafness. Future investigations will, perhaps, prove that acquired deafness has a still greater preponderance in the causation of deaf-mutism than we are at present authorized in believing.

DISTRIBUTION OF DEAF-MUTES IN VARIOUS COUNTRIES.

Country.	Year.	Number of Deaf-mutes per 100,000 Inhabitants.	Total Number of Deaf-mutes.	Proportion between Male and Female Deaf-mutes.
Europe:				
Switzerland	1870	245	6,544	
Austria	1890	123	29,217	100:74
Baden	1871	122	1,784	100:89
Sweden	1895	116	5,307	100:90
Alsace and Lorraine	1871	111	1,724	100:76
Würtemberg	1861	111	1,910	100:87
Hungary	1890	109	19,024	100:84
Norway	1891	106	2,139	100:81
Prussia	1880	102	27,794	100:83
Finland	1880	102	2,098	100:77
Bavaria	1871	90	4,381	100:94
Ireland	1880	77	3,993	100:87
Portugal	1878	75	3,109	100:73
Greece	1879	65	1,085	
Denmark	1890	65	1,411	100:89
France	1876	58	11,460	100:87
Saxony	1890	57	1,994	100:85
Scotland	1881	57	2,142	100:86
Italy	1881	54	15,300	100:76
England-Wales	1891	50	14,112	100:83
Spain	1877	46	4,625	100:65
Belgium	1875	43	1,208	100:89
Holland	1889	43	1,977	100:81
America:				
Canada	1891	100	4,819	100:86
United States	1890	66	41,283	100:81
Africa:				
Cape Colony	1890	53	802	100:78
Asia:				
British India	1891	69	196,843	100:64
Australia:				
English Colonies	1891	37	1,412	

Distribution.—We are only in possession of information as to the distribution

of deaf-mutism in Europe, the United States of America, and some European colonies. Not even all European countries have undertaken an enumeration of their deaf-mute population; Russia, the largest of them, having, for instance, no deaf-mute statistics. The table on page 435, which includes the most recent enumeration of deaf-mutes, gives their numbers in different countries, also the proportion of males and females.

It will be seen from this table that deaf-mutism is very variously distributed in the countries from which we possess statistics. The causes of the remarkably unequal geographical distribution of deaf-mutism, which will be seen from the table, are probably numerous and various. To begin with, we are involuntarily struck by the fact that the European countries, with large deaf-mute population, are the most mountainous, which is in perfect accord with the fact that deaf-mutism is more frequent in mountainous that in lowland districts. I shall later on have occasion to point out that this is not, in all probability, the result of great altitudes and peculiar geological formations, but of the unfavorable social and hygienic conditions common to mountainous countries (consanguinity, poverty, unhealthy dwellings, etc.), the importance of which as causes of deaf-mutism will be discussed afterward. Further, wide-spread and malignant epidemics of cerebrospinal meningitis, an important cause of deaf-mutism, explain the frequency of this condition in the lowland countries of Central Europe.

We must, also, observe that the countries in the west and south of Europe are the most fertile and productive, while those in the north and centre are less favorably endowed by nature. That this circumstance is a factor in the distribution of deaf-mutism has been proved by investigations made in different districts in Denmark, and especially in Saxony. Finally, the northern and central countries are, on the whole, the most thinly populated in Europe, doubtless the result of the barrenness of the soil.

Sex.—The table on page 435 shows a greater frequency of deaf-mutism among males than females, the difference in several countries being considerable. The number of female deaf-mutes per 100 male deaf-mutes varies, according to the table, from 94 in Bavaria to 65 in Spain, the average rate in Europe and the United States of America being 82 females per 100 males. The numerical superiority of male deaf-mutes is the more remarkable since females are more numerous than males in nearly all the European countries, Italy being the only country of those mentioned in the table which exhibits a slight inferiority as regards the female population. This numerical superiority of the male deaf-mutes must undoubtedly be considered principally as an expression of the greater liability the male organ of hearing has to be morbidly affected.

Symptoms and Sequelæ.—Of the symptoms, the principal are, of course, deafness and dumbness; but other symptoms closely connected with the ear disease causing deafness are often met with in cases of deaf-mutism.

Deafness.—The term "deafness" is not only used to express the absolute absence of hearing,—total deafness,—but also to express a condition in which some traces of hearing remain, but in which the human voice is not audible in the usual way: a condition to be described as partial deafness. From a theoretical point of view, it seems an easy matter to make a sharp distinction between the condition in which the auditory nerve is entirely out of function and that in

which it still acts, though deficiently. As a matter of fact, however, it has been proved that it is sometimes difficult to decide, in particular cases, whether there are any remains of hearing or not; and, further, the results of these two conditions (if acquired in early infancy or congenital) are the same, viz.: deaf-mutism. In other words, both subjects with total deafness and those with partial deafness may be met with among deaf-mutes.

It is not always an easy matter to test and decide the amount of hearing possessed by a child, especially an infant. As a rule, only ordinary loud sources of sound can be employed to discover whether the child in question reacts in any way to the sound produced; for instance, by turning or blinking its eyes. Generally, a loud whistle, a bell, clapping the hands, or such like devices are made use of. Such a rough mode of examination can, however, only decide whether the power of hearing exists or not in individual cases, and even this is often difficult when the patient is an infant, and it is also no easy matter to determine whether the power of hearing is equal on both sides. With older children it is easier to discover whether the power of hearing exists, and, if so, in what degree. In the latter case less powerful sources of sound may be employed. Of these the principal is the tuning-fork, the vibrations of which are used in measuring the conduction of sound through the middle ear, by placing it outside the ear; and also in measuring the so-called bone, or cranio-tympanic, conduction, by placing it on the mastoid process or on the teeth. The human voice is also an important means of investigation. The best means of employing it is by pronouncing certain vowels loudly and distinctly close to the deaf-mute's ear, without his being able to see the movement of the lips, the patient being asked to repeat the vowels pronounced. To prevent the possibility of guessing the vowels should be repeated several times. If the deaf-mute understands the vowels easily, consonants and even words and short sentences may be tried. In most cases this method can only be made use of when the deaf-mute in question has learned to articulate. A greater power of hearing is seldom met with, unless sound-increasing apparatus are employed. The hearing of deaf-mutes with considerable remains of hearing can also be tested with a loud-ticking watch placed outside the ear or pressed against the outer ear. It is, however, very unusual for deaf-mutes to be able to distinguish the high notes represented by the ticking of a watch. In employing all these methods, it must be remembered that the hearing of deaf-mutes differs greatly at different times in some cases, according to varying conditions in the ear, of which we have no immediate knowledge.

The reports of various investigators, as to the relative number of deaf-mutes with total deafness, differ considerably, for, while some have found that only about one-fourth of the deaf-mutes examined were totally deaf, others have found a much larger proportion, the principal cause of this discrepancy being probably the fact that there is generally a distinct relationship between the deafness and its cause. This relationship is most distinctly seen by comparing the power of hearing of congenital deaf-mutes with that of deaf-mutes with acquired deafness. All investigators, with a few exceptions, have, namely, found a much greater number of cases of total deafness among deaf-mutes with ac-

quired deafness than among deaf-mutes with congenital deafness.

The reason why so many more cases of total deafness are met with among deaf-mutes with acquired deafness than among those with congenital deafness is owed to the fact that post-natal processes in the ear causing deafness are much more destructive than the same processes occurring during fœtal life: a circumstance which has been previously pointed out. Most authors have also found that congenital deaf-mutes are more frequently in possession of a considerable degree of hearing (hearing of vowels or even of words) than deaf-mutes with acquired deafness.

It may be mentioned, finally, that Bezold examined the hearing power of deaf-mutes by means of a graduated series of tuning-forks and found that frequently "islands" of perception of notes alternated with total defects of hearing. These defects appeared most frequently in the lower end of the scale —a fact which has been corroborated by Uchermann.

Mutism.—Mutism was in early times believed to be the primary and essential symptom of deaf-mutism, but it is known now to be a secondary phenomena which is the consequence of the deafness. That this is the case is also evident, from the fact that the degree of mutism is, as a rule, in exact relation to the degree of deafness, and also to the period at which the deafness makes its appearance. Thus congenital deafness, or deafness acquired in early infancy, is always accompanied by complete mutism (excepting in cases in which the mutism is removed by special methods of education), while in cases of acquired deafness, in which the deafness is either not total or arises after the child has learned to speak, a certain degree of speech is respectively acquired or retained. The explanation is simple, speech being, under normal circumstances, acquired through the ear, the child imitating the words which it hears spoken by those about it. It may, however, be mentioned that even children totally devoid of hearing produce sounds which sometimes resemble words, such as "ma-ma," "ba-ba," etc., and sometimes also imitate animals, often thus causing their friends to suppose that they are capable of hearing. This may be because the above-mentioned sounds and the voices of certain animals are produced by very simple movements of the vocal organs which can be imitated by spontaneous observation. Finally, it is possible that the vibrations caused by such loud sounds as the barking of a dog, bellowing of a cow, etc., may be perceived by the aid of touch, which sense is often highly developed in deaf children, and consequently guides them in imitating the sounds.

The question as to the degree of deafness which must exist, or, in acquired cases, the age at which the deafness must appear in order to cause mutism resulting in deaf-mutism, cannot be answered decidedly. To begin with, the application of the term "deaf-mutism" is entirely arbitrary in cases in which there is some power of hearing or of speech, and the distinction between a deaf-mute child and a child with deficient power of hearing must in some cases depend entirely upon practical considerations, of which the method of instruction which is requisite for the child's education is, as a rule, decisive. Thus, for instance, a child of well-to-do parents, who is able to hear tunes and to a certain extent reproduce them, will scarcely be considered deaf and dumb and sent to an asylum, while a child with the same degree of hearing, but of poor parents, will be treated as a

deaf-mute, because the parents are unable to give it the special education which it requires. The non-development or deficient development of the power of speech in cases of congenital partial deafness, and its complete or partial loss in cases of acquired deafness, are also often dependent upon the assiduity with which a child's friends attend to its development or preservation. Some children, too, seem to have a greater aptitude for developing or retaining the power of speech than others, and this seems to be not only dependent upon their intellectual faculties, but also upon other unknown conditions. Thus, a child with comparatively very slight power of hearing, or with deafness acquired soon after birth, may exhibit a comparatively considerable power of speech, while another child with greater powers of hearing and later acquired deafness may be entirely without it.

Future investigations will in all probability decide how far total acquired deafness results in total mutism. Hartmann states that deafness acquired before the age of seven causes secondary mutism, and this opinion is, no doubt, correct. On the other hand, there are reports from various places to the effect that deaf-mutism may appear at the age of 14 or 15 or even later. In these cases, however, it is probable that the term deaf-mutism is incorrect, though, of course, such accidental circumstances as feeble-mindedness, blindness, etc., may necessitate the registration of persons who have lost the power of hearing so late in life as deaf-mutes, because they are unable to read from the lips, or unable to pronounce so distinctly as to be understood.

As mentioned above, mutism in deaf-mutes may be either total—*i.e.*, the power of speech may be entirely wanting—or it may be partial, in which latter case the power of speech is developed, or, in acquired deaf-mutism, it is retained to a certain extent. This power of speech is frequently considerable; so that such persons cannot, properly speaking, be termed mutes. There are, however, certain peculiarities which always attach themselves to the speech even of persons who are only partially deaf from their birth, or who have become deaf during childhood. These peculiarities, which are still more pronounced in true deaf-mutes, consist in the absence of accentuation of syllables and of words, the result being that speech becomes monotonous. Besides this, the speech of such persons is generally dull-sounding and feeble, and the control of respiration is also deficient. The stock of words is also sometimes limited, though this peculiarity is, under ordinary circumstances, not very noticeable, excepting in cases where the power of hearing is very slight, or where the deafness appears comparatively early. These physical deficiencies in the speech of deaf-mutes are easily accounted for, because the power of hearing is not only important in the development of speech by enabling a child to imitate the speech of others, but it also enables it to regulate the modulation, sound, and force of its voice by the aid of the vibrations which reach the labyrinth through the bones of the cranium.

The power of hearing plays so great a part in the above-mentioned physical qualities of speech that its loss cannot be completely compensated for by any other sense. It is, however, possible, by aid of sight and touch, to teach a great number of deaf-mutes to speak well enough to be able to use speech as a means of communication. Persons who have been totally deaf from birth can also be taught, by a special method of instruction, to speak so that they can be

understood, though with the peculiarities above mentioned. Owing to these peculiarities, such speech has received the name of "articulation." It is not always an easy matter for the deaf-mute to retain the power of speech which he has gained with so much difficulty, when he enters the world and comes in contact with persons who cannot, or can only partially, understand him. In such cases the deaf-mute generally abandons the use of speech as a means of communication, especially as lip-reading requires great attention and well-developed sight.

Disturbances of the Equilibrium.—It has been mentioned that acquired deafness is often accompanied by disturbances of the equilibrium, both at its first appearance and immediately afterward, and that this complication is most frequent in cases where the deafness has been caused by cerebrospinal meningitis. Mention is also made in literature of some few cases of congenital deafness accompanied by disturbances of the equilibrium, consisting in uncertain and staggering gait, both during the first years of childhood and later on in life. James was the first to draw attention to "immunity from dizziness," under circumstances which otherwise produce dizziness and consequent disturbance of the equilibrium, as characteristic of deaf-mutes. He examined altogether 519 deaf-mutes and found that 186—*i.e.*, 36 per cent.—did not feel the least dizziness when spun round rapidly, no matter in what position their heads were placed. James was also informed by many of these deaf-mutes that they experienced a remarkable feeling of helplessness and want of sense of locality when under water, several of them also stating that these sensations were unknown to them before the loss of hearing. Kreidl endeavored to discover in a more rational manner, and by the aid of a specially-constructed apparatus, an objective proof of the above-mentioned phenomena in deaf-mutes, and also to decide their nature and strength. Pollak endeavored to produce dizziness in a number of deaf-mutes by conducting a galvanic current through their heads. Several exhibited signs of dizziness, accompanied by movements of the head and eyes, also exhibited by normal subjects under like circumstances, while 29.3 per cent. were not affected in any way; in these, then, it was to be supposed that the semicircular canals were entirely destroyed, and Pollak points out the resemblance between the figures thus obtained and the percentage of cases of entire absence or destruction of the semicircular canals found by post-mortem examination of deaf-mutes.

Although deaf-mutism brings with it a long train of indirect consequences, which are of great importance as affecting the daily life of the deaf-mute, its more direct results are but few, and even these are the subject of dispute.

Deficient Development of the Mental Faculties.—There can be no doubt that the want of such an important sense as hearing must at least result in a slow development of the mental faculties, as the psychological function of the brain develops not only in proportion to its receptivity to impressions from without, which are so necessary for mental growth (*"nihil est in intellectu quod non antea fuerit in sensibus"*), and to the quality of these impressions, but also in proportion to their quantity, which must of necessity be diminished when one of the routes by which they reach the brain is closed or partly closed. This does not, of course, prevent a deaf-mute from attaining the same degree of intellectual development as a normal

person with the same amount of intelligence, if his physical deficiency is compensated for by energy, industry, etc. There is, however, no doubt that purely practical considerations—for instance, the necessarily-limited choice of professions—often hinder such a complete indemnification for the loss of so important a sense as hearing. The deaf-mute is thus deprived of one of the most important incentives to energy,—namely, ambition; and it is, doubtless, in these external hindrances, that the reasons are to be sought why no deaf-mute has as yet written his name on the pages of history. Further, the morbid processes causing deaf-mutism often have their seat in the brain, as has been already pointed out, and these processes often leave other traces behind them. Hartmann found also that one-half of the pupils examined by him in deaf-and-dumb asylums, whose deafness was due to brain disease, were but moderately or indifferently endowed with intelligence, and it was altogether doubtful whether many of these subjects were capable of instruction. There are also statistical proofs from other countries that deaf-mutism is often accompanied by want of mental power. It is not, however, correct to infer that deaf-mutism can result in idiocy from the circumstance that deaf-mutes are often idiots. Idiocy, when it appears simultaneously with deaf-mutism, is the result of a congenital brain disease, or one acquired in infancy, and is of superior or co-ordinate importance to the deaf-mutism itself; persons exhibiting both these abnormalities must, doubtless, not be considered as idiotic deaf-mutes, but as deaf-and-dumb idiots. H. Schmaltz and Lemcke have made some measurements of the heads of deaf-mutes in order to elucidate the question as to the intelligence possessed by deaf-mutes. Both these investigators found that the heads of deaf-mute children were, as a rule, smaller than the heads of normal children, especially in the younger age-periods. The reason is, doubtless, that the mental faculties of deaf-mute children are less developed than those of other children.

Abnormalities of the Ear Found by Objective Examination. — While the section of this paper on morbid anatomy will be mainly devoted to the pathological changes of the deeper parts of the ear, it is my purpose, under this heading, to deal with the abnormalities found in those parts of the ear which are accessible to objective examination. It would naturally be supposed that as deaf-mutism is often caused by anomalies of the ear, deaf-mutes would often exhibit congenital abnormalities of the external ear. This is, however, not the case, as congenital malformations of the external ear are but seldom met with. A close investigation of the cases of malformation of the external ear reported in literature proves also that these abnormalities are but very rarely accompanied by such a diminution of the powers of hearing as to result in deaf-mutism, which circumstance has been laid much stress upon by Toynbee. Abnormalities of the external meatus have been often met with. It is, however, often difficult to decide the nature of the abnormalities from the descriptions of them we possess, and a comparison of the frequency with which they have been found by various investigators is, therefore, of no interest. Contraction of the meatus would seem to be the abnormality most frequently met with. The greatest interest, however, attaches to the closing of this passage, which has been found by many investigators without being accompanied by any malformation of the external ear.

There can be little doubt that when the meatus is closed by a membrane situated close to the external ear this is due to congenital malformation; should the membrane, however, be situated in the neighborhood of the tympanum, it is possible that the obstruction is the result of inflammation in the tympanic cavity. I have, at least, in two cases, observed such a closing of the external meatus of deaf-mutes resulting from scarlatinal inflammation, in the one case on both sides, in the other on one.

As to otoscopic examinations of deaf-mutes, these have contributed very little to the pathogenesis or etiology of deaf-mutism. Such investigations have been published by various authors, whose researches, in spite of the care which has been bestowed upon them, have lead to very little result; in fact, the various authors differ very considerably in the results obtained. The difference observed in the results of examinations of normal children and pupils at deaf-and-dumb asylums lies in the greater frequency with which the abnormalities found appeared in deaf-mutes, and not in the nature and kind of these abnormalities. All investigators who have classified the deaf-mutes examined by them according to the nature of their deafness (congenital, acquired, or doubtful) agree that the otoscopic examination of the drum-heads in cases of congenital deafness yields a negative result more frequently than in cases of acquired deafness, the latter more frequently exhibiting destructive inflammatory processes or the traces of such.

Abnormalities of the Mucous Membranes Adjacent to the Ear.—Catarrhal changes of the mucous membranes of the nose, naso-pharynx, and pharynx have been frequently observed. These changes have most frequently taken the form of hypertrophy of the whole mucous membrane, or of the adenoid tissue (adenoid vegetations, hypertrophy and hyperplasia of the tonsils), less frequently the form of atrophy (ozæna, atrophic catarrh of the naso-pharynx and pharynx). The frequency with which catarrhal changes of the upper air-tract has been observed by investigators differs greatly. The cause is doubtless to be sought in the circumstance that catarrhal diseases of the nose, naso-pharynx, and pharynx appear with varying frequency in different countries and in different classes of society, as climate, mode of living, clothing, hygienic conditions, etc., as is well known, play an important part in the appearance of catarrh in the air-passages. The results of such examinations of deaf-mutes will, therefore, first be of use in judging of the relation of such affections to deaf-mutism, when we possess information as to the frequency with which catarrhal diseases of the upper air-passages appear in normal subjects of the same age and living under the same conditions as the deaf-mutes from which to draw comparison. It seems, however, to be, beyond doubt, that deaf-mutes suffer with great frequency from adenoid vegetations of the naso-pharynx.

Abnormalities of the Eye.—Although we find several notices of abnormalities of the eyes of deaf-mutes, it is often difficult to decide whether these are accidental phenomena or connected etiologically with deaf-mutism. Among the abnormalities of the latter category may be mentioned retinitis pigmentosa, various malformations of the eye; atrophy of the bulb caused by panophthalmia, a result of the same acute disease as caused the deafness; finally syphilitic interstital keratitis.

Diagnosis. — Although deaf-mutism

from a theoretical point of view is not a very distinctly-defined condition, still the majority of cases are easily recognized. The question whether a person is a deaf-mute or not must, according to what has been laid down in the foregoing pages, be principally decided by examinations as to the function of the auditory nerve. If this is entirely suspended, or so reduced that speech cannot be heard, and if the history of the case proves that this condition dates from birth or infancy, then the subject must be regarded as a deaf-mute. We are also justified in applying this term, as has already been pointed out, even where there exists some power of speech either acquired by special means of instruction or where the deaf-mutism has appeared at a more advanced age, retained to a greater or less extent. The circumstance that the pathological condition called deaf-mutism is based upon a symptom, the extent of which cannot be measured with any degree of certainty, but which, nevertheless, is decisive, naturally causes arbitrary decisions in some cases, which decisions generally depend upon purely practical considerations. In other words, there are persons as to whom it is difficult to say with certainty whether they are deaf-mutes or not. Such are persons who can hear the human voice to a certain extent, and who consequently learn to articulate by the aid of special methods of education, or such as have lost the power of hearing so late that they have retained the power of speech, although their voice is always somewhat peculiar. Such persons are, however, but few in number, and consequently the difficulty in diagnosing deaf-mutism mentioned here is of very slight practical importance.

Of much greater importance are the difficulties which present themselves when the person in question is an infant. It must, however, be pointed out that the term "deaf-mute" is incorrect when applied to children under a year old, as no children can speak at that age. It would seem, indeed, that great caution must be observed in drawing the conclusion that deaf-mutism will necessarily be the result of even total deafness observed during the first year of infancy, since, according to the experience of many etiologists there are some children who are unable to react, or who react very slowly, to sounds during the first year of infancy, but whose hearing, nevertheless, when older, is perfectly normal. In any case it is extremely difficult to arrive at any decided opinion whether an infant possesses the power of hearing or not, and especially as to what degree of hearing it possesses, and, as a rule, the younger the child, the greater is this difficulty. The reason is, doubtless, that the sound-conducting apparatus of infants is not complete at birth. The external meatus and the tympanic cavities are transformed after birth from cavities filled with cellular tissue to pneumatic cavities. It was formerly supposed that infants did not react to sound, but it has been proved that this is not the case, even with newborn infants, and infants can also perceive musical notes. Even in the second half of the first year of childhood it is, however, very difficult to decide whether the power of hearing exists or not. No great confidence can be attached to the statements of a child's friends as to its having heard certain sounds, as the vibrations of the air caused by certain sources of sound may produce effects upon the sensory nerve which may be mistaken for the result of vibrations of air acting upon the auditory nerve. It is, therefore, of the greatest importance, in experimenting with the hearing

of infants, to make use of such sources of sound, or to make use of them in such a manner, that only the vibrations of sound produced can be perceived. Loud dinner-bells are suitable for this purpose; the so-called watchman's whistle, Galton's whistle, clapping of hands, and the firing of small pistols, which the child should not be allowed to see. If the child reacts to these sounds it will blink its eyes or exhibit either joy or fear.

Should the results of such experiments be negative, it is not necessary, as before mentioned, to conclude that the child will become a deaf-mute. After the completion of the first year of infancy, however, the older the child, the greater the importance which must be attached to such negative results. After that period we may look for another symptom to help us in our diagnosis, viz.: the absence of speech. This, too, may be delusive, as some children, although in full possession of normal powers of hearing and intellect, do not begin to speak at the end of their first year, but later, sometimes much later. The cause may be some hidden condition or constitutional disease; for instance, rickets.

Another condition which may be mistaken for deaf-mutism is simple mutism (aphasia) uncomplicated with deafness or idiocy. This abnormality, which is not at all rare in adults as the result of certain brain diseases, is but seldom congenital or acquired in infancy, at least, there are but few references to it in literature. This form of aphasia must, according to some authors, be regarded as the result of a disease which is localized in the central nervous system, causing total inability of speech in the person affected, or inability to speak more than a few indistinct words. This infantile aphasia, which seems, as a rule, to be congenital, differs from the mutism of deaf-mutism, principally inasmuch as it is not accompanied by deafness, and often, also, in the subject affected being able to produce certain words or sounds resembling words, which are always employed in attempts at speech. Aphasia accompanying feeble-mindedness, imbecility, or idiocy is a much more frequent abnormality, which is still more easily mistaken for deaf-mutism, especially in such cases where the imbecility is so considerable that the interest for sound is diminished. In these cases, however, the imbecility, which must be regarded as the primary disease, will generally show itself in the patient's appearance, movements, gestures, etc.

Hysterical mutism may sometimes simulate deaf-mutism. It is, however, generally accompanied by pronounced symptoms of hysteria, and exhibits itself by the patient's making no attempts to speak, or even to articulate. It is generally of short duration and easily recognized, the diagnosis only offering some difficulty in cases where the mutism appears in deaf, hysterical subjects.

The question whether deaf-mutism is congenital or acquired is, doubtless, that which offers the greatest difficulty in forming a diagnosis of deaf-mutism. In all cases, however, when the deafness appears after the child has begun to speak, or where the immediate causes of deafness are known, the diagnosis is an easy matter. If, on the contrary, the deafness has made its appearance prior to the period at which speech is generally developed—whether the morbid changes of the organs of hearing causing deafness are congenital or acquired—a decision as to the fœtal or post-fœtal origin of the deafness is accompanied by great, indeed often insurmountable, difficulties. In such cases it is, therefore, of the greatest

moment to obtain the most explicit information from the deaf-mute's friends, especially the parents, who are most likely to be able to give reliable information as to the diseases and pathological conditions which exist in the family. An opinion as to the origin of deaf-mutism can, as has been previously mentioned, only in exceptional cases be based upon objective examination of the subject. Such exceptional cases are, for instance, those in which visible and pronounced malformations of that part of the ear which is accessible to examination clearly indicate that deaf-mutism is the result of congenital changes of the auditory organs. Such cases are, however, very rare. Malformations in other parts of the body also indicate, though with a much less degree of certainty, that the condition in the ear is congenital; but these cases are rare. The objective examination of the ear, in the great majority of cases, offers nothing which can be relied upon with any degree of certainty, since, on the one hand, pathological changes of the external and middle ear, which may, according to their nature, be acquired after birth, may very well exist in persons whose deafness is due to congenital malformations of the auditory organ; while, on the other hand, less-pronounced congenital changes of the external and middle ear (for instance, lesser degrees of microtia and macrotia, contraction of the external meatus, abnormal position of the drumhead, etc.) may very well appear in persons with acquired deafness.

A final decision as to the congenital or acquired origin of a case of deaf-mutism must, then, in the majority of cases, be entirely based upon inquiry, and, even when explicit information is obtainable, it is often difficult to arrive at a definite opinion. It will be always advisable to make inquiries whether the child's speech has developed in the same way as that of ordinary children of the same age, because non-professional persons' statements as to a child's power of hearing are often unreliable. Should the answers be in the affirmative, and should it be proved that the power of speech has been lost, or is arrested in its development from some or other cause (acute brain disease, scarlet fever, measles, etc.), it may be safely concluded that the deaf-mutism is of post-fœtal origin. This diagnosis is also justified, though with less certainty, when the above-mentioned causes have shown themselves during the first years of infancy, unless, of course, ample and satisfactory proof can be produced that the child has never possessed the power of hearing, or that the more remote causes of deaf-mutism (unfavorable social conditions, heredity, consanguinity, etc.) have appeared in great force; in such cases a decision must remain doubtful. Should, however, the possibility of the direct causes (scarlet fever, brain diseases, measles, etc.) be excluded, and it is proved that the child never possessed the power of speech, it may be supposed that the deaf-mutism is the result of congenital changes of the organs of hearing. This supposition is the more warranted the greater proof there is that the more remote causes of deaf-mutism have played their part in the case in question.

Etiology.—The causes of deaf-mutism may be subdivided into two groups: (*A*) the remote causes, and (*B*) the immediate causes.

(*A*) Remote Causes.—Among these are to be mentioned principally natural conditions, unfavorable social and hygienic conditions, heredity, consanguinity and a few others of minor importance.

Natural Conditions.—In considering

the unequal distribution of deaf-mutism, we are involuntarily led to the supposition that this phenomenon may be caused by varying natural conditions, among which soil and elevation seem to play an important part.

To H. Schmaltz is due the honor of having investigated the question of the importance of geological conditions and elevation in Saxony so thoroughly that his results are entirely to be relied on. In these investigations, which have embraced the minutest details which could possibly be of importance concerning the appearance of deaf-mutism, the author has weighed each separate point carefully. His conclusions are as follow: There is nothing to be said in favor of the hypothesis that soil, climate, or other territorial conditions influence the deaf-mute rate, neither can the composition of the water be proved to affect it in any way, but it is the social and hygienic conditions which are decisive. Lemcke, in Mecklenburg-Schwerin, and Uchermann, in Norway, were also unable to prove that geological conditions are a cause of deaf-mutism.

Unfavorable Social and Hygienic Conditions.—Almost all authors who have considered the question of the connection between deaf-mutism and unfavorable social and hygienic conditions, agree in ascribing to them great importance as causes of deaf-mutism. The statistical proofs in support of this hypothesis are not, however, on the whole, very satisfactory. The best statistics are furnished by H. Schmaltz, who has come to the following conclusions: "The industrial population, and especially that part of it which is worst off pecuniarily,—in fact, all who are in danger of degenerating both morally and physically on account of insufficient means, or poverty, and who consequently are unable or unwilling to take the necessary care of their children,—all such persons exhibit the highest percentage of deaf-mutes among their descendants. Finally, when, in addition to all these unfavorable conditions under which children are born, they are brought up by a family which, from various reasons, is, perhaps, more or less degenerated, and have to undergo all sorts of diseases in infancy without having sufficient power of resistance, thus deaf-mutism is an only too common result." On the other hand, Uchermann states that in Norway unfavorable social and hygienic conditions are far from increasing the deaf-mute rate, it being higher among the better-situated classes.

Heredity. — Opinions have differed greatly as to the heredity of deaf-mutism, the reason being that not only are the laws which govern the hereditability of pathological changes and diseases subject to different interpretations, and that the statistics employed have given different results, but also that the term "heredity" is used in different ways.

The term "heredity" is used by many authors to express the frequent appearance of the same pathological condition in two consecutive generations, other influences having, of course, been excluded. The statistics which have been employed in attempts to solve the question of the frequency with which deaf-mutism appears in two consecutive generations have been based on two different methods: the one calculating how often deaf-and-dumb persons had deaf-and-dumb parents, the other how frequently unions where the one or both parties were deaf and dumb resulted in deaf-and-dumb offspring.

The first mode of ascertaining the frequency with which deaf-mutism appears in two generations, consisting in discovering how often deaf-and-dumb subjects

belonging to large groups of deaf-mutes are descended from deaf-and-dumb parents, everywhere gives the result that deaf-mutes very seldom have deaf-and-dumb parents. This is even the case when only congenitally deaf have been the objects of investigation, Uchermann, for instance, finding in Norway among 921 deaf-mutes with congenital deafness only 2 with deaf-and-dumb parents. This seems to prove that deaf-mutism is rarely inherited in the strictest significance of the term, or, as it might also be expressed, inherited directly. It must, however, be borne in mind that marriages contracted by deaf-mutes are, and especially have been, comparatively rare in Europe, and also that their fertility is smaller than that of other marriages; there can certainly be no doubt that the direct hereditability of deaf-mutism is certainly of much greater importance than might be supposed from the above-mentioned statistics.

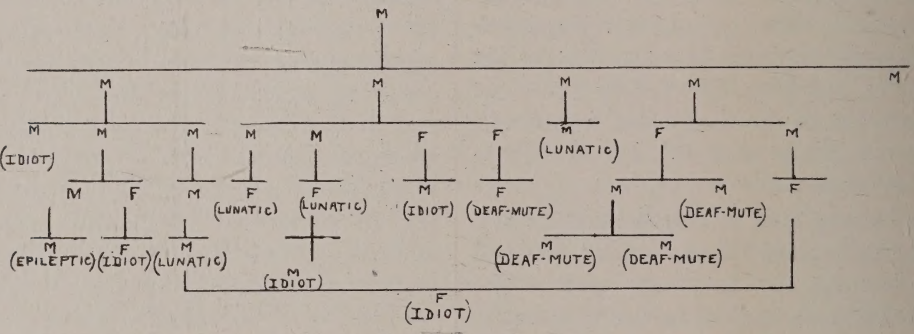
This opinion is corroborated by statistics founded on the second mode of estimating the frequency with which deaf-mutism appears in two consecutive generations, viz.: by calculating how frequently unions where one or both parties are deaf and dumb result in deaf-mute offspring. The European statistics of this kind are but few and small, the reason being mentioned above, while the excellent American statistics collected by E. A. Fay are very comprehensive, marriages contracted by deaf-mutes being so much more frequent in the United States. The principal results of European statistics have been that a deaf-and-dumb child was born in about every thirtieth or thirty-first union where one party was deaf and dumb, and that deaf-mute offspring were much more frequently the result of unions where both parties were deaf and dumb. The statistics published by Fay are based on investigations of over 5000 marriages contracted by deaf-mutes and have given the result that over 9 per cent. of these resulted in "deaf offspring, and, curiously enough, the marriage where both parties were deaf did not result more frequently in deaf offspring than those where only the one party was deaf." Fay also found that marriages of congenital deaf persons and of deaf persons with deaf relatives gave a far greater liability to deaf offspring.

If, now, the term "heredity" is used to express the conspicuous frequency with which the same abnormality appears in the same family, the hereditability of deaf-mutism becomes still more evident. The frequency with which deaf-mutism appears among the parents of deaf-mutes has been mentioned above. Cases of deaf-mutism among the grandparents, great-grandparents, etc., of deaf-mutes, which should prove the direct heredity *per saltum*, as it is termed, must necessarily be still less frequent, as marriages between deaf-mutes were very rare in the first half of this century. If we, however, look for cases of deaf-mutism in other branches of the deaf-mutes' family-tree, we find in all statistics that—considering that deaf-mutism is a comparatively-rare pathological condition — a great number of deaf-mutes are to be found among the uncles, aunts, great-uncles, great-aunts, cousins, and second cousins of deaf-and-dumb persons. According to European statistics, embracing a large number of deaf-mutes, about every sixteenth deaf-mute has one deaf-and-dumb relative among the category above mentioned (parents, grandparents, brothers, and sisters excepted), the point where deaf-mutism most often appears corresponding to generations co-ordinate with the parents. These statistics have

also shown that it is almost exclusively congenital deafness which plays a part in this respect. Deaf-mutism, finally, is to be met with more frequently among the brothers and sisters of deaf-mutes, and there are statistics as to congenital deaf-mutes according to which 50 per cent. of these had one or more deaf-and-dumb brothers or sisters. The appearance of deaf-mutism in two or more children of the same parents is very characteristic, and there are few pathological conditions which show such a tendency to appear in the same branch of a family, there even being cases on record where ten deaf-and-dumb children were born in the same marriage.

Finally, if by heredity we understand the frequent appearance in a family of not only one pathological condition, but of several others related to it anatomically or etiologically, we shall see that heredity is a most important factor in the etiology of deaf-mutism. It is, namely, proven by several comprehensive statistics that partial or total deafness due to different ear diseases (which have not led to deaf-mutism, on account of the lesser degree of the loss of hearing or of its unilateral appearance, or of its later development in life), insanity, epilepsy, idiocy, stammering, and other defects of speech, hysteria, and several other nervous diseases appear with conspicuous frequency among the relatives of deaf-mutes and with about double the frequency among the relatives of congenital deaf-mutes as among the relatives of deaf-mutes with acquired deafness.

Their appearance is particularly clearly demonstrated by several genealogical tables published by Dahl and Uchermann, of which the one depicted below is an interesting example.



M, male. *F*, female.

[Albinism, retinitis pigmentosa, and malformations are also frequently found among the relatives of deaf-mutes; these anomalies are probably to be considered as signs of degeneration, deaf-mutism itself being undoubtedly in several cases a degenerative phenomenon. These anomalies, however, might also be considered as "nervous abnormalities." HOLGER MYGIND.]

The laws which may, then, be supposed to regulate the heredity of deaf-mutism are difficult of interpretation, and seem in many respects to differ from those which relate to other pathological conditions and diseases. This may be accounted for by supposing that, as the causes of deaf-mutism in general are numerous and varied, so are also the causes of each individual case. The circumstance that deaf-mutism, so far as its etiology is concerned, must be divided into two distinct classes, the congenital and the acquired, the latter of necessity including numerous cases in which deaf-

ness is to be traced to accidental causes, is alone sufficient to render the interpretation of the laws of heredity, by the help of investigations which embrace deaf-mutes in general, of the greatest difficulty. When we add to this that, although the importance of heredity in deaf-mutism is undoubted and considerable, there are other factors of at least equal importance, and that there is much which tends to neutralize the transmission of morbid tendencies (favorable social conditions, crossed marriages, etc.), it will be evident that there is much which renders a just explanation of the laws of heredity anything but an easy task. If we compare deaf-mutism with hæmophilia, which it resembles so far as heredity is concerned, we shall see how correct the above statements are. Hæmophilia—which, like deaf-mutism, may pass over several generations and accumulate in a single, being also most frequent among males and in the children of fruitful marriages—is, etiologically, but little complicated, partly because it is not related to any other anomaly, and partly because heredity is the governing cause. With deaf-mutism it is very different. It, too, may accumulate in single generations, being most frequent in brothers and sisters and much less frequent in the older generations. In these, however, there can be found a comparatively large number of cases of partial or total deafness, insanity, epilepsy, etc., which seems to indicate that deaf-mutism is, in many cases, a combined result of the transmission of various influences. These influences fall into two groups: those which originate in ear diseases, and those which originate in nervous disease in the family. Now, as the morbid anatomy of deaf-mutism proves that in the majority of cases the deafness causing deaf-mutism arises from abnormalities of the nervous parts of the auditory organ,—the labyrinth,—there is reason to suppose that in many cases deaf-mutism is caused by the transmission of the above dual influences through the parents. Supposing this hypothesis to be correct, our knowledge of the laws of heredity in deaf-mutism assumes at once a more distinct form, though we cannot ever expect it to be as clear as it is, for instance, in regard to the laws which govern hæmophilia, for, as above mentioned, the causes of deaf-mutism are too numerous and varied. Even twins, who would seem to be exposed to exactly the same influences during fœtal life, are sometimes the one a deaf-mute, the other a normal subject.

Consanguinity.—The question of the importance of consanguinity as a cause of deaf-mutism has been a fruitful subject of discussion. The first decidedly-expressed opinion upon this topic appeared in 1846, when Ménière and Puybonnieux, who were, respectively, medical attendant and teacher at the State Deaf and Dumb Institution in Paris, laid great stress upon the important part which consanguinity played in deaf-mutism, without, however, producing statistics in support of their theory. Such, however, appeared shortly after in the returns of the Irish census of 1851, which was the first to include this question in its rubrics, and, from the results thus obtained, Wilde came to the conclusion that "among the predisposing causes of mutism the too-close consanguinity of parents may be looked upon as paramount." Vulliet, Landes, Chazarain, Bemiss, Howe, Dahl, Boudin, Mitchell, and the undaunted defender of the doctrine of consanguinity, Devay, were all in favor of the importance of this factor in the etiology of deaf-mutism, while Bourgeois, Périer, Huth, Voisin,

and G. Darwin were more or less opposed to the hypothesis that consanguineous marriages predispose to degeneration in the offspring, deaf-mutism being generally the principal object of their arguments. Statistical information as to the frequency of consanguinity among the parents of deaf-mutes has also been forthcoming, the frequency with which deaf-mutes are reported as being born in consanguineous marriages varying from 1.6 to 9.4 per cent., while the percentage for deaf-mutes with congenital deafness varies from 2.8 to 23.0 per cent.

It will be seen, then, that statements as to the frequency with which deaf-mutes are born in consanguineous marriages differ considerably. This can most naturally be explained as resulting from various circumstances. To begin with, such marriages vary in frequency in different countries; thus, in Prussia they form only 0.8 per cent. of all marriages; in France 1 to 2 per cent.; and in England 3 per cent. at the outside; in Denmark 3 to 4 per cent., in Saxony 4, and in Norway over 6.65 per cent. Further, there is no doubt that the frequency of consanguineous marriages differs in the different confessions and classes of society, in cities, and in the country, and here, also, in different districts. It must also be observed that the various statistics sometimes embrace whole countries, sometimes single districts, and sometimes deaf-and-dumb institutions, clinics, etc. The information in question has also been obtained in different ways; for instance, by reports, censuses, individual investigations, etc., and finally the different authors have included different degrees of relationship.

Although many investigators have found comparatively few deaf-mutes born in consanguineous marriages, there are several circumstances which seem to prove that consanguinity is an important factor in the etiology of deaf-mutism. They are the following:—

Several statistical reports, the reliability of which cannot be doubted, are to the effect that deaf-mutes are comparatively often born of consanguineous marriages, and there seems to be reason to lay greater stress upon such positive results than upon those pointing in a negative direction.

All authors are unanimous in declaring consanguineous origin to be more common among congenital deaf-mutes than among deaf-mutes in general. This indicates that it is deaf-mutes with acquired deafness who reduce the rate that expresses the frequency with which deaf-mutes in general are born in consanguineous marriages. That consanguinity plays a part in congenital deafness only, or almost only, may be seen from the circumstance that all authors who have occupied themselves with this subject have come to the result that deaf-mute children born of consanguineous marriages are, in the majority of cases, born deaf, while only a small majority become deaf after birth.

That consanguinity is of importance in the etiology of deaf-mutism is evident from the circumstance that several authors have proved that, among the marriages of which the deaf-mutes are born, the consanguineous unions produce a larger number of deaf-mutes than the crossed.

Finally, several statisticians have proved that, the closer the degree of relationship between the parents, the larger was the number of deaf-mute children born.

It will be seen that there are various circumstances which clearly indicate that the intermarriage of relatives plays no insignificant part in the etiology of deaf-

mutism. Everything, however, tends to prove that it is entirely, or principally, in congenital deafness that consanguinity is an important etiological factor.

It is, however, undecided whether consanguinity in itself is a remote cause of deaf-mutism, or whether it is through the intensified transmission of hereditary, morbid conditions or tendencies prevalent in a family that it makes itself felt. Theoretical considerations and a few lately published investigations in Norway by Uchermann are strongly in favor of the latter supposition; still it is but fair to say that up to the present there have not been many or convincing facts brought forward in its support.

There are, then, but few facts which serve to elucidate the question whether the influence of consanguinity upon deaf-mutism is direct or indirect. Further investigations of the same nature will, perhaps, throw more light upon this subject. The final solution of the question will, however, in all probability, only be brought about by means of information as to the family, supported by an exact knowledge of the relatives of the deaf-mutes, and supplemented by their thorough objective examination. It is only thus that it will be possible to find less pronounced, but not on that account less important, abnormalities in the family, and to discover with what frequency the influence of heredity can be, with certainty, excluded in consanguineous marriages resulting in deaf-mute children.

There are, besides the above mentioned, several other remote causes, which are, more or less properly, supposed to play a part in the etiology of deaf-mutism; of these the most important are the following:—

Alcoholism in the Parents.—Although the abuse of alcohol is extremely common, and although we have no information as to its frequency, on the whole; still, several reports seem to indicate that alcoholism in the parents plays some part in the etiology of deaf-mutism. Among the most important facts as to this question must be mentioned those stated by Uchermann in Norway, where, in cases of deaf-mutism of non-hereditary origin, alcoholism was found with double frequency among the parents of the deaf-mutes with congenital deafness than among parents of deaf-mutes with acquired deafness. It is at present impossible to form any accurate opinion as to whether alcoholism makes itself felt by weakening the parents' constitution, or whether it is an expression of a nervous disposition.

Syphilis in the Parents.—This disease has, on the whole, been found comparatively seldom among the parents of deaf-mutes. This does not, however, prove that syphilis plays no part in the etiology of deaf-mutism, for it is often difficult to discover, by questioning, whether a person has, or has not had, this disease, and it is also possible that investigations have, up to the present, been deficient in this particular. It is, at all events, certain that syphilis in the parents may produce a form of deafness in the children, appearing in the later years of childhood, and often leading to deaf-mutism. This form of deafness will be mentioned more particularly under the special etiology of acquired deaf-mutism.

Age and Difference in Age of Parents.—Ménière was the first to draw attention to these two factors in the origin of deaf-mutism, stating that, according to his experience, deaf-mutes were often the children of young parents, and that such marriages were frequently sterile or resulted in weakly offsprings. Later investigations have, however, not confirmed this.

Fertility of Marriages.—All authors who have directed their attention to this subject agree that marriages producing deaf-mutes are remarkable for their fertility. According to Uchermann, this may be explained by supposing that, the greater number of children there are born, the more strongly the hereditary disposition to deaf-mutism, hæmophilia, etc., shows itself.

(*B*) Immediate Causes.—According to recent statistics, in about one-half of the cases of acquired deaf-mutism the deafness is acquired during the first three years of infancy, the greater number of cases falling in the third (statistics from the United States) or the second (European statistics) year of life; then comes the fourth, the first, the fifth, sixth, and so on.

Brain Diseases.—These play an important part in deafness acquired after birth and resulting in deaf-mutism. The Irish statistics of 1881 show the lowest figure, viz.: 11.9 per cent.; and the Pomeranian report the highest, viz.: 54.5 per cent. It will be seen that the importance of brain diseases in the etiology of deaf-mutism varies considerably in the different countries; this is not only due to the circumstance that the expression "brain disease" includes different affections in the different reports, but also to the varying intensity with which cerebral disease appears at different times and at different places. All modern investigators agree, however, that brain diseases are at present the predominant cause of acquired deaf-mutism.

There can be no doubt that the most frequent brain disease leading to deaf-mutism is *epidemic cerebrospinal meningitis*, the deleterious influence of which has been especially pointed out by Moos. We possess various clinical observations of partial or complete deafness caused by epidemic cerebrospinal meningitis, and post-mortem examinations of persons whose deafness is due to this disease or other similar brain diseases, which elucidate the manner in which cerebral affections act deleteriously upon the infantile organs of hearing. The great conformity which exists between the changes in the auditory organs caused by cerebrospinal meningitis and changes declared to be due to inflammation of the brain in general, or to other diseases with pronounced cerebral symptoms, authorizes us to suppose that the facts related in the following paragraphs hold good for the majority of cases of deaf-mutism caused by acute brain disease.

Clinical experience teaches us that the very considerable defects in hearing which appear during epidemic cerebrospinal meningitis may have a dual origin, viz.: inflammation of the middle ear or an affection of the labyrinth. Loss of hearing from the former cause is, however, seldom so considerable or so lasting as to result in deaf-mutism. Deafness resulting from labyrinthine disease is more rare, but, at the same time, of more importance, since the loss of hearing is, as a rule, very considerable, often, indeed, total, generally affecting both sides, and nearly always permanent. According to Moos and Knapp, labyrinthine deafness in epidemic cerebrospinal meningitis generally appears suddenly, seldom gradually. As a rule, it appears in the course of the first two weeks, but may also show itself later; Knapp reports a case where it appeared even six weeks after the commencement of the disease.

Acute Infectious Diseases.—The importance of this group of diseases in the etiology of deaf-mutism is doubtless at present less marked than that of brain diseases. If, however, epidemic cerebro-meningitis is included among acute in-

fectious diseases,—to which group it doubtless belongs,—they immediately assume a very prominent place, and there can be no hesitation in declaring that the great majority of cases of deaf-mutism caused by acquired deafness are the result of acute infectious diseases. The importance of the parts played by the different diseases varies greatly, as will be seen, scarlet fever predominating.

Scarlet fever (scarlatina). This disease has always and in all countries been recognized as a very frequent cause of infantile deafness, and, consequently, of deaf-mutism. The influence of scarlet fever on deaf-mutism differs, however, in different countries and at different times, which is doubtless due to the varying intensity and character with which the disease appears. The lowest figures are represented by statistics from Italy (1.5 per cent.), the highest from Saxony (47.6 per cent.).

The origin of deafness in scarlet fever has been elucidated by clinical research, which proves that ear diseases caused by scarlet fever generally consist of inflammation of the middle ear, with a marked tendency to destroy the mucous membrane and osseous walls of the tympanum, and also the auditory ossicles. The inflammations of the middle ear, which are most frequently propagated through the Eustachian tubes, but which may, perhaps, appear independently, are not, as a rule, in themselves capable of causing a diminution of hearing in infancy so lasting and so considerable as to result in deaf-mutism, unless the labyrinth is affected. Scarlatinal deafness resulting in deaf-mutism is then, doubtless in most cases, due to a partial or entire destruction of the membranous contents of the labyrinth. This destruction is, in many cases, caused by the propagation of the inflammation to the internal ear either through the fenestræ (fenestræ rotundis et ovalis) or through the vessels leading from the tympanum to the labyrinth. Some post-mortem examinations of deaf-mutes, whose deafness was the result of scarlet fever, support the former theory, indications of an inflammation of the middle ear being found, also abnormalities in one or both fenestræ, doubtless the result of an inflammatory process. On the other hand, there are various circumstances which indicate that scarlatinal affections of the labyrinth may appear independently of an inflammation of the middle ear, or that, if such inflammation had existed, it has been very slight. Thus, for instance, it is often found, on otoscopic examination of deaf-mutes, who have become deaf after scarlet fever, that the drum-head exhibits but slight or no abnormalities.

Measles (morbilii). The reports relating to the frequency of measles as a cause of deaf-mutism vary greatly, though not so much as was the case with scarlet fever, which disease also assumes a much more prominent rank in the etiology of deaf-mutism; the lowest rate is Wurtemburg and Baden (1.0 per cent.), the highest Mecklenburg-Schwerin (8.3 per cent.).

Among other infectious diseases which now and then cause deaf-mutism may be mentioned the different varieties of typhus (typhoid fever, exanthematic typhus), diphtheria, small-pox, chicken-pox, erysipelas, dysentery, influenza, ague, whooping-cough, mumps, inflammation of the lungs, and rheumatic fever.

Constitutional Diseases.—Of these may be mentioned rickets, scrofula and syphilis. Although syphilis is represented in most statistics relating to the causes of deaf-mutism by only a fraction or not at all in modern statistics, there can be

no doubt that when inherited from the parents it plays some part in deafness acquired in infancy and resulting in deaf-mutism. Inherited syphilis may, as is well known, produce a peculiar form of deafness accompanied by certain ocular affections, which, it is true, generally appears after the age of puberty, but which, however, also shows itself before that period, even as early as the age of four. The circumstance, however, that hereditary syphilitic deafness often appears without any other marked symptoms of syphilis, and that it is extremely difficult to discover syphilis in the parents, especially by questions alone, explain why this disease is so seldom noticed in the parents of deaf-mutes in hitherto-published statistics. It seems, also, that acquired syphilis may cause deaf-mutism; but no investigators have, up to the present, touched upon this subject.

Injury (*Trauma*). — Although it is probable that traumatic influences, such as falls, blows on the head, etc., to which children are especially subject, are sometimes stated as being the cause of deaf-mutism in cases of really congenital origin, there is no doubt that such causes may produce deafness resulting in mutism, as ear diseases of traumatic origin are not at all unknown, even among adults. Injury also is included in the causes of deaf-mutism in nearly all the more considerable statistics, the figures, however, being but small.

Morbid Anatomy.—Although a partial examination of the auditory organs of deaf-mutes during life-time is possible, still it can only embrace the peripheral parts, and there must always be a difficulty in deciding whether the morbid changes thus revealed are of primary or secondary importance, or, indeed, only accidental. It is, therefore, only possible to arrive at an intimate knowledge of the morbid changes causing deaf-mutism and hence, at the just comprehension of its nature, by means of post-mortem examination. We have but few reports of such examinations dating earlier than the commencement of this century, and they yield so little information that we can only surmise that the examinations have been incomplete.

Before discussing the different parts of the auditory organs in which morbid changes have been found, it must be observed that several investigators have found no changes whatever in some of the cases examined by them; indeed, Ibsen's and Mackeprang's investigations gave negative results in no less than one-third of all their cases. As, however, these investigations date from a period when the microscopical examination of the labyrinth was but little developed, and as no mention is made of an examination of the brain or of the auditory nerve, the negative results arrived at lose considerably in importance, for it is possible that the parts of the auditory organ above mentioned have been the seat of undetected abnormalities.

Morbid Changes of the Middle Ear.— If we take a survey of the pathological changes of the middle ear which have been found in post-mortem examination of deaf-mutes, we shall find that such changes are remarkably frequent. It is only exceptionally that these have been the result of malformation; they have, in the majority of cases, owed their presence to inflammatory processes or the remains of such. These inflammatory processes have sometimes been of catarrhal nature, but generally suppurative, in which cases they have been intense and destructive. The abnormalities which are characteristic of the morbid anatomy of deaf-mutism have had

their seat about the two fenestræ, especially in and around the fenestra rotunda, which has exhibited anomalies in not less less than one-fourth of all the dissections which yielded positive results, and has in particular been frequently closed by osseous masses. In the majority of cases, however, the abnormalities of the middle ear have been accompanied by marked changes of the inner ear.

Morbid Changes of the Labyrinth.—These have affected either the whole labyrinth or only parts of it. The so-called entire absence of the labyrinth plays an important part among the former class, partly on account of its comparative frequency, and partly on account of its origin. The majority of authors have hitherto regarded the absence of the labyrinth as the result of arrested development. I have, however, in several of my works proved that partial or complete absence of the labyrinth, or of parts of it, may be, and probably most frequently is, caused by the deposit of osseous tissue in the labyrinthine cavity, which becomes thus more or less completely filled up, under which process the normal outlines may disappear entirely. Such a formation of osseous tissue is without doubt the result of a previous inflammatory process; that is, of an *otitis intima*. I have also pointed out that it is impossible to distinguish between fœtal and post-fœtal morbid changes by post-mortem examination, unless accompanied by exhaustive and reliable information as to the cause and date of the affection. From the following it will be evident that the deposit of osseous tissue in the cavity of the labyrinth is one of the most frequent labyrinthine anomalies found upon post-mortem examination of deaf-mutes, the osseous mass sometimes filling the whole cavity, while sometimes only a section exhibits a parietal deposit which has merely caused a diminution of the cavity in question. The most extensive formations of osseous tissue in the labyrinth are apparently the result of a post-natal *otitis intima*. It is interesting to observe that various investigators have discovered such osseous deposit sometimes on the one side only, sometimes on both, some having also found osseous tissue on the one side, and deposits of chalk or fibrous tissue—which may also, as is well known, be the result of inflammatory processes—on the other side, while both the latter deposits have also been frequently found in the labyrinths of deaf-mutes when there was no formation of osseous tissue on either side. Inflammatory and also degenerative processes may leave other products behind them, which may appear in like manner in other parts of the body. I would not, however, imply that the partial or total absence of the labyrinth may not be the result of arrested development, which, on the other hand, may be due to fœtal inflammatory processes. Still, it is often difficult to find proofs that such has been the origin of the abnormalities in individual cases. A case observed by Michel is, however, of this nature, as the petrous bone was entirely deformed, and it seems as if we might be justified in expecting important malformations of the labyrinth to be reflected in the shape and appearance of the petrous bone. In many cases the inflammatory process in the labyrinth causing its partial or complete destruction was secondary to an inflammation of the middle ear. According to the reports of several post-mortem examinations, the inflammation of the middle ear was due to acute infectious diseases, in particular scarlet fever and measles. In conformity with the above,

it will be seen that in dissections, in which the complete or partial absence of the labyrinth was discovered, tolerably well-marked changes were found in the middle ear, consisting, in great part, in the remains of inflammatory processes; and this was true of many of the cases which will be mentioned further on as examples of circumscribed deposit of osseous substance in the labyrinth. On the other hand, the absence of inflammatory processes in the middle ear, or the traces of such, and in other cases the histories of the cases seem to indicate that the labyrinthine inflammation is not of necessity propagated from the middle ear, but that it frequently originates in the membranes of the brain. This is especially probable in all cases where meningitis is with certainty stated to be the cause of deafness. There is, perhaps, a third kind of labyrinthine inflammation,—viz., primary inflammation,—which has been especially defended by Voltolini and called after him *otitis intima* of Voltolini. The existence of this affection cannot be proved or disproved by arguments drawn from the material here under discussion.

As far as the seat of the labyrinthine changes in deaf-mutes is concerned, the vestibule (with the exception of its aqueduct) is the part of the labyrinth which has been least frequently found to be the seat of morbid changes. The reason is that the vestibule is, comparatively speaking, seldom found to be abnormally changed on post-mortem examination of deaf-born deaf-mutes, anomalies in the two other principal sections of the labyrinth being twice as frequent in these cases. It is also remarkable that in no hitherto-published post-mortem examination of a deaf-mute with acquired or congenital deafness, or where the origin of the deafness is not stated, has the vestibule been the only section of the labyrinth which has been the seat of abnormalities, the other sections being also changed when this has been the case with the vestibule.

The semicircular canals are decidedly the portion of the labyrinth which is most frequently the seat of pathological changes; these are, indeed, so frequent here, that more than one-half of the dissections have yielded positive results. Indubitable cases of congenital malformations have been observed by several investigators, but it is questionable whether such abnormalities as the union of the two canals into one, shortening or lengthening of the canals, etc., are to be regarded as of vital importance. In not less than one-fifth of all the dissections yielding positive result the semicircular canals were the only part of the labyrinth which exhibited morbid changes. In the majority of cases in which the semicircular canals have been the seat of abnormalities they, or a part of them, have been filled up by osseous tissues, or must have been supposed to have been so; for instance, in the many cases where the reports simply mention "absence" of these canals. The posterior canal has been most frequently attacked, either above or together with the superior, but principally together with both the superior and the external. There is no reason to presume the frequent occurrence of abnormalities of the semicircular canals to be a frequent cause of deaf-mutism, but only a conspicuous proof of the frequency with which labyrinthine inflammations are a cause of that anomaly. The abnormalities discovered in the semicircular canals point also in another direction when it is remembered that it is an approved fact that disturbances of the equilibrium are very common among deaf-mutes. In this

respect post-mortem clinical observations of deaf-mutes speak strongly in favor of the theory of the influence of the semicircular canals on the equilibrium of the body: a theory which has lately found much support in Ewald's work.

Morbid changes of the cochlea are somewhat more frequent than those of the vestibule, and are very equally divided between congenital and acquired cases of deaf-mutism. In several cases the cochlea was the only part of the labyrinth which was the seat of morbid changes; in the great majority of cases, however, other parts of the inner ear have been abnormal, the semicircular canals having been at the same time especially frequently the seat of anomalies. The more or less entire filling up by osseous or calcareous masses is the anomaly most common to the cochlea, and under this heading may doubtless be included all cases in which the cochlea is reported to be entirely absent, or in which only one or two cavities remained. Abnormalities of this nature are mentioned in about one-eighth of all hitherto-published post-mortem examinations.

Morbid Changes of the Auditory Nerve.—It is a fact that, although atrophy and degeneration of the auditory nerve, or a part of it, are frequent in deaf-mutes, they are far from being always present, as believed by many, since Hyrtl put forward that supposition, based upon post-mortem examinations performed by him. As it is to be supposed that the auditory nerve of the majority of deaf-mutes examined post-mortem has been out of function some time, without there being found any atrophy or degeneration in it or its branches, it would seem that this nerve is not particularly disposed to become atrophied or degenerated from inactivity. The correctness of this hypothesis is confirmed by morbid anatomical examinations hitherto published of persons who have become deaf at a more advanced age, which examinations all point in the same direction. The cases of atrophy or degeneration of the auditory nerve which have been found by post-mortem examinations of deaf-mutes, seem, therefore, as a rule, to be due to some other cause, and we are obliged to regard them as the result of either centripetal atrophy or degeneration subsequent to labyrinthine destructive processes, or as the expression of a centrifugal change arising from primary disease of the central nervous system.

It is impossible as yet to give any satisfactory reason why the auditory nerve in some deaf-mutes is atrophied or degenerated while in others it is not. The question will doubtless be cleared up by a larger number of post-mortem examinations of deaf-mutes, accompanied by reliable information as to the origin of the deafness.

Examination of 415 young deaf-mutes, in regard to primary cause and to the condition of the ears, the nasal chambers, and organs of phonation. A. A. Bliss (Med. News, Nov. 19, '92).

CONDITION OF THE EARS.

	Group 1.	Group 2.	Group 3.	Total.
Plastic otitis media	75	20	16	111
Adherent and immovable drum-heads	94	28	3	125
Very feebly movable drum-heads	43	12	4	59
Atrophic drum-heads	2	0	0	2
Engorgement of manubrial vessels and pinkish tint of drum-head	6	3	1	10

CONDITION OF THE EARS (*continued*).

	Group 1.	Group 2.	Group 3.	Total.
Calcareous deposits in drum-head	14	2	0	16
Double perforations with otorrhœa	9	5	3	17
Single perforations with otorrhœa	10	5	1	16
Cicatrized perforations, many of them covered with new membrane	32	13	3	48
Double impactions of cerumen	14	5	0	19
Single impactions of cerumen	15	7	2	24
Atresia of external auditory meatus	2	0	0	2
Undeveloped auricles with absence of auditory meatus	1	0	0	1
Foreign bodies	6	0	0	6
Desquamative otitis externa	4	0	0	4
A slight trace of hearing	6	17	2	25
Hearing on contact only	62	6	10	78
Fair hearing	0	2	0	2

PRIMARY CAUSE.

	Cases.		Cases.
Spotted fever	43	Cholera infantum	1
Scarlet fever	66	Shock	1
Measles	17	Mumps	1
Meningitis	29	Bronchitis	1
Typhoid fever	5	Catarrhal fever	1
Pneumonia	2	Sun-stroke	1
Diphtheria	2	Otitis media	9
Malaria	2	Whooping-cough	2
Small-pox	1	Teething	3
"Colds"	13	Croup	1
Convulsions	10	Eczema	1
Black fever	3	Unknown (exclusive of 137 pupils credited as being deaf-mutes from birth)	49
Traumatism	9		
Spinal meningitis	5		
Inflammation of bowels	2		

PATHOLOGICAL CONDITIONS PRESENT.

Nares.	Group 1.	Group 2.	Group 3.	Total.
Deformities consisting of deviated septa, exostoses, hypertrophied turbinals, causing partial or complete occlusion of one or both nares	65	14	4	83
Posterior hypertrophies of turbinals	21	1	2	24
Impactions of middle turbinals against the septum	14	3	0	17
Synechial bands between the septum and lower turbinals	2	2	0	4
Sclerosis of mucous membrane in the anterior nares	35	7	5	47
Sclerosis in posterior nares	13	8	0	21
Atrophy of nasal mucous membrane	20	2	0	22
General catarrhal condition due to vaso-motor paresis without deformities	13	3	0	16

PATHOLOGICAL CONDITIONS PRESENT (*continued*).

	Group 1.	Group 2.	Group 3.	Total.
Adenoids in vault of pharynx, causing partial occlusion of this space or pressure upon the Eustachian openings....	57	14	8[2]	79
Tongue.				
Abnormally-short frænum.....	24	0	1	25
Hypertrophy of the lingual tonsil worthy of note.....	12[1]	1	0	13
Palate.				
Abnormally high, narrow, and Gothic-arched	8	0	2	10
Deflection of raphé from median line, most frequently to the left side.....	6	0	0	6
Double uvula.....	2	0	0	2
Relaxed and pendulous soft palate.....	2	0	0	2
Tonsils.				
Large tonsils filling the spaces between the faucial pillars of their own sides of the throat, but not adherent to these bands, or not causing serious occlusion or pressure upon surrounding parts.....	32	16	1	49
Tonsils greatly hypertrophied, diseased, and causing pressure upon the palate or tongue, and greatly occluding the faucial space.....	18	5	4	27
Adhesion between tonsil and faucial pillars, the tonsil being incapsulated.....	30	6	5	41
Narrowing of fauces by broad posterior pillars with high attachment to the pharyngeal walls.....	11	0	0	11
Pharynx.				
Simple hypertrophy of mucous follicles..	23	3	2	28
Sclerosis of mucous membrane with follicular hypertrophy.....	9	6	0	15
Simple sclerosis of mucous membrane..	55	20	5	80
Atrophy of mucous membrane.....	8	1	1	10
Venous engorgement worthy of note...	22	2	3	27
Larynx.				
Epiglottis abnormally depressed.....	14[3]	2	0	16
"Infantile" epiglottis.....	2[4]	0	0	2
Vocal Bands.				
Apparently normal in color and ordinary movement	83	63	12	158

[1] Six of these were in pupils between 14 and 22 years old; the other six in pupils under 14 years of age.
[2] These eight cases all occurred in subjects between 12 and 19 years old.
[3] Only four being in pupils under 14 years of age.
[4] Both being in pupils over 14 years of age.

Examination of 175 deaf-and-dumb children. Tested by a large bell, a large

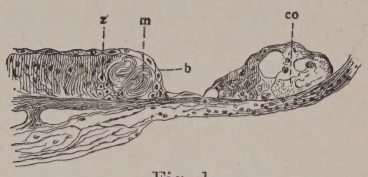


Fig. 1.

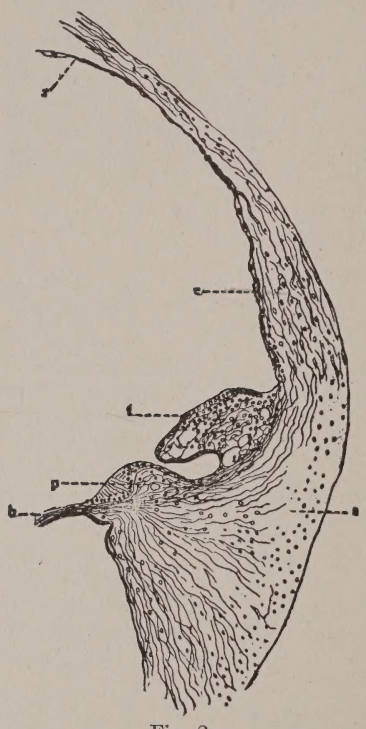


Fig. 2.

Auditory atrophy and anomalies of development in the membranous labyrinth of both ears in a case of deaf-mutism. (*Scheibe.*)

Fig. 1.—*co*, Corti's organ; *z*, increased cells in the sulcus spiralis; *b*, arched layer of cells, extending to the limbus laminæ spiralis osseæ; *m*, Corti's membrane.

Fig. 2.—*s*, Stratum semilunare; *b*, beginning of basilar membrane; *p*, prominentia spiralis; *l*, ridge on the stria vascularis; *e*, flat cells on the rest of the stria; *r*, a piece of Reissner's membrane, bulged forward toward the scala vestibuli; inserted somewhat peripherally, and extending, farther on, in a thicker layer of cells.

(Zeitschrift für Ohrenheilkunde.)

tuning-fork, and the human voice. The children were found to divide themselves into:—

1. Those stone-deaf or having no aërial hearing,		9
2. Those hearing very loud sounds,—shouting, etc.,		81
3. Those hearing and distinguishing the voice:—		
(*a*) Vowels only,	20	33
(*b*) Consonants and words,	13	
		123
Disqualified for testing because of youth, idiocy, etc.,		49
Dumb, but hearing perfectly,		3
		175

Of the 9 totally deaf, by far the larger number were cases of congenital deafness. Of those who could hear and distinguish the voice, much the larger number were cases of acquired deafness. The causes of acquired deafness were found to be, in half the cases, primary disease or injury in the brain or internal ear, without apparent disease of the middle or external ear. Measles and scarlet fever were found responsible for 13 cases. Sixty-one cases of normal membrane were found among the 175 children; 32 showed suppurative disease, and nearly 80 catarrhal changes. The pharynx was diseased in most of the cases. J. K. Love (Glasgow Med. Jour., June, '93).

Post-mortem examination of the ears of a deaf-mute. The case was that of a young man, aged 18 years, who died from pulmonary and intestinal tuberculosis. When 2 1/2 years old he suffered from scarlatina, and, as a result, became a deaf-mute. In the right ear the pathological conditions were confined to the labyrinth, and consisted of destruction of its integral parts, the various spaces having undergone ossification. The drum-head and tympanum were quite normal. The ligamentum annulare stapedis and the membrana fenestræ rotundæ were ossified; but this process was confined to the sides adjoining the inner ear. In the left ear were found otorrhœa, ossification of the spongy portion of the pars petrosa and of the processus mastoideum, and ossification of the membrana fenestræ rotundæ; the ligament of the stapedius muscle was movable. The inner ear showed no sign of pathological fluid or new formations. The surface of the brain showed no ab-

normality. Broca's convolution appeared smaller than normal. The superior temporal convolution of the left side was also smaller than usual. The microscopical examination did not show any positive signs of abnormality. These cerebral changes are supposed to result from atrophy consequent upon the inactivity of the parts, it being worthy of

detailed examination, the middle ear was found to be normal, except for an hyperplasia and degeneration of the tensor tympani muscle. The labyrinth showed atrophy of the nerves of the cochlea, sacculus, and posterior ampulla, as well as alterations in the membranous structure of the cochlea and sacculus. The latter are simple anomalies of forma-

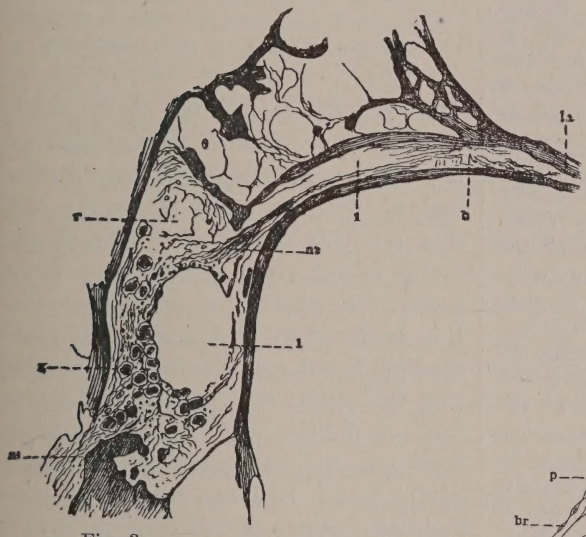


Fig. 3.

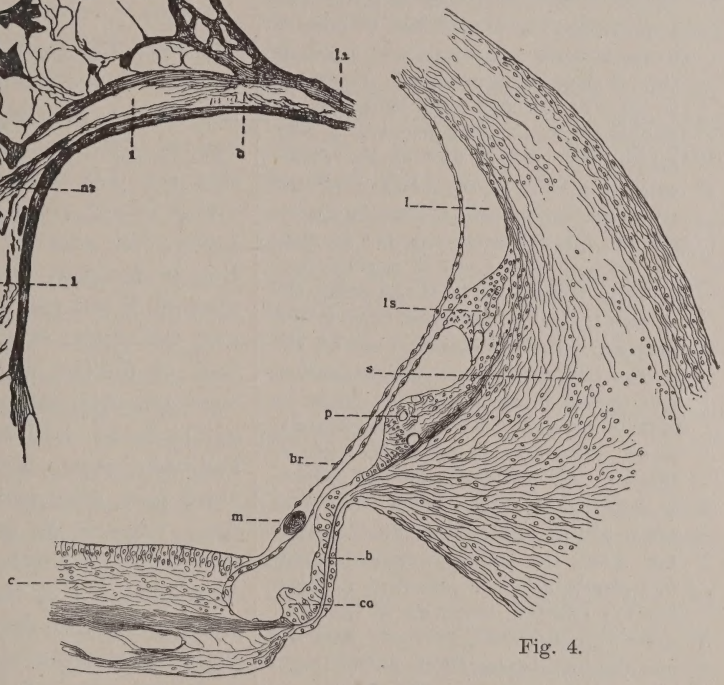


Fig. 4.

Auditory atrophy and anomalies of development in the membranous labyrinth of both ears in a case of deaf-mutism. (*Scheibe.*)

Fig. 3.—*r*, Rosenthal's canal; *la*, lamina spiralis ossea; *g*, ganglion-cells; *l*, lacuna; *nl*, entering nerve-fibres; *n2*, departing nerve-fibres; *b*, connective tissue.

Fig. 4.—*s*, Semilunar stratum; *c*, crista spiralis; *b*, basilar membrane; *co*, Corti's organ badly preserved; *p*, prominentia spiralis; *br*, bridge; *l*, lacuna in the stria vascularis; *ls*, ridge with attachment to the lower part of the bridge; *m*, rudimentary Corti membrane.

(Zeitschrift für Ohrenheilkunde.)

note that this left-sided atrophy is associated with destruction of the right labyrinth. Conclusion that there is good ground for the belief that the fibres of the acoustic nerve cross in the brain. V. Uchermann (Annual, '93).

Case of a deaf-mute, aged 47 years, who died of phthisis. As a result of

tion. Deaf-mutism in this case must be regarded as due chiefly to the atrophy of the nerves. In the labyrinth there is no trace of a former inflammation. The case thus differs from all similar ones before reported. (See Figs. 1, 2, 3, and 4.) Arnold Scheibe (Archives of Otol., Jan., '92).

Literature of '96 and '97.

Examination of the reactions for general and painful sensations in forty-four deaf-mutes with the faradimeter of Edelmen, and of the retinal sensitiveness (field of vision) with the instrument of Landolt. Conclusions: The reactions to general sensitiveness and to pain, in the deaf-mute, are very little inferior to the normal. In early life, indeed, there is no difference worthy of note. So also with regard in general to the field of vision; it is normal both in extent and form, except for a readiness to fatigue, which by itself is anything but a serious sign of marked degeneration. The sensitiveness of the deaf-mute evidently expresses a mental development of a very satisfactory quality, and clearly differentiates him from such classes as the criminals, the epileptics, and the feeble-minded (partial imbeciles), not to mention more marked forms of degeneration. In spite of the absence of one sense, the sensitive zone of the deaf-mute is not deficient. Various stimuli from all the sources in the sensorium reach his cortex, and this is in such condition as to be able to normally elaborate the stimuli; hence comes ease of perception and attention. All the other sensorial sources, if exercised, can supply the want of a source so full of ideas as is that of hearing, when the centre is normal. This fact should help our judgment in forming the scientific diagnosis of the deaf-mute. Deaf-mutism, by itself, does not mean serious degeneration. S. Ottolenghi (Jour. of Laryn., Jan., '96).

Case in which there were atrophic changes in the fibres of the cochlear branch occupying the first whorl, the corresponding portion of Corti's organ being reduced to a mere trace, while in the upper whorls it was lower than normal, the membrane being rolled up in the rudimentary way. This and other allied conditions indicated a congenital defect or arrest of development. A. Scheibe (Arch. of Otol., vol. xxiv, Nos. 3 and 4, '97).

Deaf-mutism is the result of aural disease acquired in infancy consecutive to acute rhinitis. From neglect there follows atrophy of the acoustic nerves. These cases would be curable if the nerves could be stimulated to proper development by vibrations carried through the cranial vault. Twelve deaf-mutes thus cured, but it required several years. The naso-pharynx received particular attention; the drum was mobilized by means of Politzer's inflator and by the apparatus of Delstanche, the patients also receiving oral instructions. Acute rhinitis in children should be carefully watched and treated. Verdos (Annales des Mal. de l'Oreille du Larynx, No. 5, '97).

Morbid Changes of the Brain (Cerebrum).—The defective development of the surface of the third convolution and of the insula Reilii of the left side may be mentioned as an abnormality several times discovered in deaf-mutes, but which has no causal relation to deafness. Rüdinger and Waldschmidt found this abnormality in several deaf-mutes who presented no history of disease, and whose labyrinths were not examined, while other investigators found it in two deaf-mutes who had both become deaf after birth, in the third year, after meningitis and scarlet fever, respectively, and who both exhibited pronounced abnormalities in the ear. The flattening of the cerebral convolutions is doubtless due to atrophy, caused by the inactivity of the parts of the brain which are known to be the motor centre of speech, on account of the inactivity of the muscles of speech. In the two latter cases, also, there was information proving that the deaf-mutes in question had never learned to speak.

Case of deaf-mutism, in an adult, found at the autopsy to have been due to symmetrical lesions in the two temporal lobes. The entire cranial capacity was less than normal, the brain weighing 935 grammes (30 ounces), and the left hemisphere was almost one-fourth smaller by weight than the right. The first and second temporal convolutions were destroyed, normal being replaced by

cicatricial tissue, while the third convolutions—the supramarginal and the angular gyri—were atrophied and sclerosed. The convolutions of the island of Reil were intact on the right, but largely destroyed on the left; acoustic nerves very thin. The patient presented notable deficiency of intellect, with absolute deafness and dumbness. She possessed a certain amount of intelligence, however, and could comprehend, to a certain degree, mimetic language. No motor paralysis of trunk or limbs existed, nor was there any defect present in vision or cutaneous sensibility. Seppilli (Alienist and Neurologist, Apr., '93).

If we cast a retrospective glance over the foregoing facts it will be seen, first, with regard to the nature of the morbid changes met with in the hearing organs of deaf-mutes, that they do not differ, so far as their quality is concerned, from those generally found in ear diseases, but that the difference must be rather sought in the intensity and extent of the morbid processes. The abnormalities found in deaf-mutes may, at least in a great number of cases, be most naturally interpreted as being the results of intense and wide-spread inflammatory processes. This is particularly evident in cases referring to deaf-mutes who had become deaf after birth. It will further be seen that the abnormalities found in cases of congenital and acquired deafness often present exactly the same appearance; so that in many cases it is impossible to decide, from the post-mortem examination alone, whether the changes are of fœtal or post-fœtal origin. It is, thus, evident that the formerly accepted opinion, that deaf-mutism arising from congenital deafness was due to congenital malformations of the auditory organs, has not been confirmed, since abnormalities which are the indubitable expression of such malformations are but seldom met with. So far as the seat of the abnormalities was concerned, it was found that these were, as a rule, bilateral, but have often differed greatly on either side, both as to character and localization, and especially as to intensity. The few cases in which the principal abnormalities were confined to the one side, while the other was normal or only the seat of unimportant anomalies, must, for the present at least, be looked upon with suspicion. Finally, it has been proved that the middle ear has very frequently been the seat of changes, accompanied, as a rule, by important abnormalities in the inner ear. These were most frequently situated in the semicircular canals, least frequently in the vestibulum, and were to be considered as the principal cause of deafness. The auditory nerve in many cases exhibited signs of atrophy and degeneration and a few other abnormalities, while in a considerable number of cases no changes were visible. In some few cases the brain deviated somewhat from the normal.

Deaf-mutism is, therefore, from an anatomical point of view, in most cases to be considered as a result of an abnormality of the labyrinth.

Prognosis.—There is no doubt that the prognosis of the deafness which is the cause of deaf-mutism is highly unfavorable, still there exist some well-authenticated cases of deaf-mutes whose power of hearing has been at least partially restored.

Treatment.—It is as yet difficult to say in what cases treatment is indicated, as we have not reached further than to the first experiments in that direction. I have latterly endeavored to act according to the following rules when deaf-mutes have been brought to me for treatment: Treatment is most decidedly indicated when the deaf-mute suffers from suppurative inflammatory processes of

the middle ear. Treatment can, at least in such cases, remove or diminish the danger which always attaches to suppuration of the midde ear. Uchermann's experience also proves that the defects in the power of hearing may be diminished in cases of this nature. Treatment is also, I think, indicated in cases in which there are some traces of the power of hearing, and especially when this power exists with varying intensity, and where there are also symptoms of catarrhal conditions in the middle ear (catarrhal changes of the membrana tympani, retraction of the manubrium of the malleus, occlusion of the tubæ, etc.); also catarrh of the mucous membranes adjacent to the ear, especially when there also exist hypertrophy of the adenoid tissue in the naso-pharyngeal cavity. If the cranio-tympanic conduction still exists, the chances in this group of cases seem more favorable still. In cases of catarrh of the middle ear and adjacent mucous membranes, where no signs of hearing can be discovered after repeated examination, I have also attempted treatment; though I am not certain that such a course gives any hopes, as my experience has not been very favorable in this group of cases.

To all the above-mentioned groups the indications are the same, whether the deafness is congenital or acquired. Various circumstances, which have been pointed out in the foregoing pages, indicate that total deafness resulting from acute infectious diseases, especially cerebrospinal meningitis and scarlet fever, and accompanied by slight catarrhal changes, is due to a constant labyrinthine disease which defies all treatment.

So far as the nature of an ultimate treatment is concerned, it must be observed that general and special otological principles must be used as guides, and the treatment, in the majority of cases, should be local.

Treatment in other than the above-mentioned cases of deaf-mutism is, of course, justified when it is not accompanied by any danger to the patient, when it is indicated by otological principles, and when it is certain that the anatomical cause of the deafness is not situated in the brain. It is for the future to show what chance of improvement such cases have.

Urbantschisch's treatment is also worthy of mention. It consists in regular acoustic exercises, intended either to awaken or improve the power of hearing in deaf-mutes; and there is every reason to look forward to more exhaustive information as to the results of such treatment with considerable interest.

Literature of '96-'97-'98.

Instrument intended to facilitate treatment by Gellé's auditory exercises, and produce the voice automatically by means of clock-work with an intensity which is subject to regulation. It consists of a horizontal cylinder run by clock-work, on which wax is spread for receiving the registration. An apparatus placed in front of the cylinder bears a membrane with a rounded style, to which is attached a little special microphone, with micrometric vise, springs, and levers. An electric current is passed into the special microphone, and into a receiver like that of a telephone. When the receiver is brought to the ear, the words, or sounds, repeated by the phonograph are heard with an intensity which can be regulated at will by increasing the number of cells. By increasing the force of the current the sounds can be made so intense as not to be endured without violent pain. Dussaud gives the receiver of a similar instrument devised by him to the deaf of all kinds and degrees. He is said to be able to make even deaf-mutes keep time to music and distinguish vowels and words. Each cylinder can repeat 10,000 times what it

contains without any alteration. Re-engraved, this can be repeated forty times; thus each word can be repeated 400,000 times, and there are fifty words on a cylinder. A sixty-cell current is at first needed for the worst cases. At the end of a few months one cell will complete the process where a cure is being effected. The number of cells used makes the instrument an audimeter which measures the degree of deafness. On the principle of Urbantschisch and Gellé, who claim that many deaf ears need only education to give them a certain amount of hearing power, this apparatus should be of signal service in the teaching of deaf-mutes. Laborde (Practitioner, Apr., '98).

The above remarks on the treatment of deaf-mutism have exclusively dealt with the deafness from which the mutism results. I will not go further into the treatment of mutism by special methods of instruction, because this subject is not included in the aim of this article, which is prepared for those who are to give their attention to the diseases involved.

It will then be seen that when a child is proved to have such deficient power of hearing that mutism is the result, removal of that deaf-mutism by treatment can only be hoped for in very exceptional cases. Therefore, there is still greater reason for considering the question of the prevention of deaf-mutism. The principle method of obtaining this object must be to submit all children who suffer from deafness which threatens to cause, or has caused, deaf-mutism to a rational examination of the ears and of the adjacent mucous membranes, and eventually to make the existing disease the subject of rational treatment.

HOLGER MYGIND,
Copenhagen.

DELIRIUM. See TYPHOMANIA.

DELIRIUM TREMENS. See ALCOHOLISM, ACUTE ALCOHOLIC DELIRIUM.

DEMENTIA. See INSANITY.

DENGUE. See MALARIAL FEVERS.

DENTAL CARIES. See TEETH.

DENTITION. See TEETHING.

DERMATITIS.

Definition.—Inflammation of the skin.

Varieties.—There are seven varieties of dermatitis: dermatitis traumatica, due to traumatic irritation of the derma; dermatitis venenata, due to contact with poisonous agents; dermatitis medicamentosa; dermatitis herpetiformis; dermatitis gangrenosa; dermatitis maligna; and dermatitis exfoliativa.

Dermatitis Traumatica.

Under this heading are included such superficial inflammations of the skin as follow pressure, violence, contusions, abrasions from scratching or rubbing, or the action of mechanical irritants of any kind.

Literature of '96 and '97.

Case of dermatitis from Roentgen rays in a boy aged 16. On October 13th, to radiograph the spine, a Crookes tube was placed about 5 inches from the epigastrium, a flannelette shirt intervening between the tube and the skin, while the trousers were turned down on each side. An exposure of one hour was made, the the coil being run by means of an accumulator. The next day the skin felt irritable and was of a deep-red color in the area subjected to the rays. The irritability increased, and, six days after the experiment, the skin felt stiff when he bent his body. Vesicles began to form, and they increased in size and number. The general surface was of a dusky- or purplish- red, forming an irregular band three-quarters of an inch wide round the umbilicus. On October 31st the whole of the epidermis had separated, and the skin was quite sound and

level with the surrounding skin, except where the vesiculation had been most pronounced. The downy hairs with which the abdomen was rather thickly covered were still present on the site of the affected area. H. Radcliffe Crocker (Brit. Med. Jour., Jan. 2, '97).

Case of a man, aged 35 years, on whom an attempt was made to get a Roentgen photograph of the renal region. The exposure lasted one hour. Three hours later he felt nausea. Six days later another attempt was made, this time the exposure being with a somewhat stronger battery for an hour and a half. After the patient left he again felt nauseated. Next day the abdomen was slightly red; there was no itching or pain. On the third day redness was more intense. On the fourth day vesicles appeared, ran together, broke, and formed, eighteen days after the second exposure, a patch seven and a half by eight and a fourth inches. It looked like an irritative eczema, with exfoliated epidermis and a profuse sero-purulent discharge. Sixteen weeks after the second exposure the sore was three by three and a half inches and covered with a thick, leathery, insensitive, false membrane. H. C. Drury (Brit. Med. Jour., Nov. 7, '96).

The inflammation of the skin sometimes noticed in connection with fluoroscopic or sciagraphic observations is due to the absorption of radiant energy by the cells of the skin, and comparable to the changes effected in the photographic emulsion. Dermatitis appears more likely to ensue from exposure to low than to high vacuum-tubes, the vast majority of rays with the former being unquestionably absorbed by the skin, while with the latter but few are absorbed. Jones (Jour. Amer. Med. Assoc., Nov. 6, '97).

The inflammatory action is usually simple, unless the tissues become infected by staphylococci or streptococci, when pus-formation or erysipelatous inflammation may follow. A common form of simple dermatitis is that resulting from chafing; while this, under the name *intertrigo*, is usually classed among the congestive erythemas, it more frequently runs into true inflammation.

The most frequent sites for the intertriginous dermatitis are the armpits, perineum, and insides of the thighs and the under-surfaces of pendulous breasts, especially in corpulent women. It is more frequent in summer than in winter, as free perspiration, macerating the upper layers of the skin, and undergoing decomposition, with the formation of irritant compounds, promotes the occurrence of the inflammation.

Intertriginous dermatitis is very frequent in infants and young children, especially if great care is not taken to keep the genital and anal regions clean and dry. The most aggravated dermatitis of the genitals, insides of the thighs, and lower part of the belly may develop in a few hours in an infant allowed to lie in a wet and dirty napkin. The pain, itching, and burning are sometimes very intense, preventing sleep and keeping the child in a state of high, nervous tension, crying and irritable.

Treatment.—In simple traumatic dermatitis any soothing application will be useful. Cold cream, oxide-of-zinc ointment, or simple vaselin are usually sufficient to allay the inflammation. One of the best applications is hot water, applied for five or ten minutes several times a day. The water should not be merely warm, but as hot as can be borne without discomfort.

For intertriginous dermatitis the writer has found black-wash the best application. Applied on lint saturated with the preparation, it usually gives prompt relief from the burning and pain and controls the hyperæmia. A mild calomel ointment, $^1/_2$ drachm to the ounce of vaselin is also useful. In other cases Lassar's paste is useful. This is made as follows:—

℞ Acidi salicylici, gr. x.
Pulv. amyli,
Zinci oxidi, of each, ʒij.
Vaselin, ʒss.
M. ft. pasta.

Great care should be taken that only the finest powdered salicylic acid be used in making this and other ointments containing it. The crystallized acid usually proves extremely irritating to an inflamed or sensitive skin.

For the moderate grades of intertrigo or chafing, a simple dusting-powder of starch and oxide of zinc is generally sufficient, if the irritated skin be kept clean and dry. The interposition of a fold of lint or soft linen between opposing surfaces of skin is an aid to the cure as well as the prevention of intertriginous dermatitis.

Dermatitis Venenata.

Definition.—Inflammation of the skin produced by external irritating agents derived from the vegetable, mineral, or animal kingdoms.

Literature of '96 and '97.

Records of some unrecognized forms of dermatitis venenata. Thus, a papulovesicular eruption, accompanied by much heat and itching, may attack the hands and arms of persons employed in weeding parsnips, or in otherwise handling them. The upper part of the body of a man who had applied to his shoulder, on account of rheumatism, a mixture of hamamelis and laudanum, became covered with large vesicles, papules, and oozing areas. Here, no doubt, an idiosyncrasy to opium may have existed. The hands of a girl employed in dipping wooden toothpicks in oil of cassia, to give these an agreeable odor, were, in a few days after she commenced this occupation, inflamed, and covered with vesicles and moist areas; her face was red and blotchy, and the lower portion of the abdomen was similarly affected, probably from contact during sleep. A number of firemen, to whom new black cotton shirts had been issued as part of their summer uniform, became affected with a brilliant-red infiltrated erythema on those portions of their body where the shirt came in contact. Solar heat and consequent perspiration seemed to have brought out the activity of the dye. Analysis proved the pigment an aniline one. James C. White (Boston Med. and Surg. Jour., Jan. 28, '97).

Varieties. — (*A*) DERMATITIS FROM VEGETABLE IRRITANTS.—A large number of plants, some of them used medicinally, possess irritant properties when brought in contact with the skin.

Rhus, or Poison-ivy. — Among the above the most important are various species of *rhus*; namely *Rhus toxicodendron*, or poison-ivy; *Rhus venenata*, or poison-sumach; and *Rhus diversiloba*, or poison-oak. The latter, according to J. C. White, is a native of the Pacific coast, although the common *R. toxicodendron* is also vulgarly known as poison-oak.

When a person, susceptible to the poison of one of these species of *rhus*, touches the plant, or, in some cases, even comes within a short distance of the same, the skin shows signs of irritation manifested as follows: There may be redness, but more frequently the first objective sign is the eruption of groups of small vesicles, accompanied by swelling and intense itching. In consequence of the scratching set up, the vesicles are ruptured and exude an abundant serum. The swelling is sometimes very great, especially about the loose tissues of the face and the genital regions. The eruptions usually begin upon the hands, as these are the parts of the body most frequently brought in contact with the poison. From the hands it is generally transferred to the face, and next, in the male sex especially, to the genitals, be-

cause the face and genitals are the parts most frequently handled. The face and head are often so intensely swelled as to be almost unrecognizable.

> [I have a vivid recollection of a personal attack of this eruption. When a boy I had frequently exposed myself to the poison without becoming affected. After a residence of some years in the city, I deliberately exposed myself, on a visit to the country, and within twenty-four hours my hands and face were swelled, covered with vesicles, and intensely itching. In the course of the next twelve hours the genital organs became swelled and studded with vesicles. Sleep was impossible from the most intense irritation. The scratching produced erosions, exudations of serum, and the formation of crusts, which finally fell off, leaving a slightly-reddened and somewhat exuding surface beneath. The itching was only partially controlled by the frequent application of concentrated solution of common salt. The eruption lasted about a week. GEORGE H. ROHÉ.]

Sometimes the skin is very much reddened and the exudation abundant. Excoriated patches are frequent. The itching varies from mild grades to the most severe intensity, but is generally a prominent symptom. It is said that death has followed the poison, but the testimony upon this point is rather vague.

The common belief that an eruption caused by *rhus* poisoning is liable to recur annually without renewed exposure is not based upon sufficiently-definite evidence. The fact that the dermatitis recurs at about the same time each year is to be attributed to a new exposure. White, however, mentions a number of cases in which a different eruption followed—after an interval—the attack of *rhus* poisoning.

The chemical nature of the poison of the various species of *rhus* is somewhat obscure, but a number of researches indicate that it is a volatile acid. A number of cases are on record showing that handling dried specimens of the poisonous plants may produce an eruption. The time after exposure when the eruption appears differs in different persons. The shortest is, perhaps, four or five hours, while in some cases it may be as many days before the effects of the poison on the skin are manifested. That the poison before volatilization may be transferred from one portion of the body to another—as from the hands to the face or to the genitals—is beyond question.

> Case of dermatitis venenata conveyed to a patient in the obstetrical ward of a hospital by the attendants, who had, just before the patient's delivery, gathered a quantity of poison-ivy, and then, although having previously carefully washed their hands, had manipulated the patient's abdomen. J. Abbott Cantrell (Med. News, Oct. 24, '91).

Literature of '96 and '97.

It has been hitherto accepted that the toxicodendric acid described by Maisch was the active principle of *rhus* poisoning, but found to be merely acetic acid. A poisonous oil, however, termed "toxicodendrol," is the toxic element,—a very intense skin irritant, even in minute quantity. Like cantharides, it can produce nephritis and fatty degeneration of the kidneys, and it is probable that fatal results of *rhus* poisoning may have been due to renal complications. It is non-volatile; actual contact appears necessary. The activity of toxicodendrol in minutest traces may make it possible for a few pollen grains of poison-ivy to cause skin eruption; and the few cases of action at a distance, which are so often quoted, may conceivably be thus explained.

The rational indication is to get rid of the poisonous oil which may be on the skin as quickly as possible; the parts should be well washed, and scrubbed with soap and water, or alcohol. Fatty preparations, being oil solvents, if used,

tend but to spread the evil. Pfaff (Jour. Exp. Med., Mar., '97).

Treatment.—The most effective applications in the early stages of *rhus* poisoning are alkaline solutions, soap being especially useful on account of its detergent effect. By its early use, the greater portion of the poison can be removed, or its effects neutralized, before it has had time to penetrate the skin and act as an irritant. Solutions of bicarbonate of soda, 1 ounce to the pint, and black-wash usually relieve the itching promptly. Hardaway, of St. Louis, recommends very highly a lotion of zinc sulphate, $^1/_2$ drachm to the pint of water. Fluid extract of grindelia robusta, either full strength or diluted with water in various proportions, is highly lauded by Van Harlingen and others. When the vesicles have ruptured, drying or absorbent powders of starch, chalk, oxide of zinc, orris-root, lycopodium, etc., may be used with good effect. Astringent lotions, among which acetate of lead holds a high place, are especially useful when the eruption is fully developed.

James C. White, of Boston, recommends the following prescription:—

℞ Zinci oxidi, ʒiv.
Acidi carbolici, ʒj.
Aquæ calcis, Oj.—M.

This should be applied freely and repeatedly over the affected parts. It alleviates the intense itching and hastens the involution of the inflammatory process. Internal remedies are unnecessary and useless.

Arnica and Other Toxic Agents.—The tincture of arnica is so freely used as an external application to bruises and sprains that it may be useful to the practitioner to know that it sometimes produces a decided dermatitis, which may be accompanied by vesiculation. The cessation of the application, and dressing the affected part with a soothing or mildly-astringent lotion (bicarbonate of soda, borax, sulphate of zinc) will generally suffice to restore the normal condition of the part.

Among other agents used for medicinal purposes, which produce dermatitis of varying intensity, are mustard, cowhage, chrysarobin, ipecac, capsicum, mezereum, thapsia, cantharides, oil of turpentine, tar, creasote, paraffin, petroleum, pyrogallic and salicylic acids, chloral-hydrate, sulphur, iodine, mercurial preparations, and the more active alkaline, acid, and mineral caustics.

The knowledge may also be useful that the juice of the common buttercup of the fields and the garden nasturtium may cause decided inflammation of the skin.

> Dermatitis caused on four occasions by using iodoform in as many patients operated on. In the second instance the hand also had accidentally come into contact with the iodoform; this lead to dermatitis of the area thus exposed. On the two latter occasions the dermatitis was accompanied by erysipelas, and led to prolonged pigmentation. This shows that no breach in the skin is required to produce this inflammation. Matschke (Ther. Monats., Oct., '93).
>
> Case showing untoward effect of resorcin applications: a single application sufficient to set up a violent dermatitis. R. W. Taylor (Jour. of Cut. and Genito-Urin. Dis., Apr., '95).
>
> [These artificial eruptions provoked by resorcin are relatively frequent, and this substance should only be used with much precaution, beginning with almost infinitesimal doses and suspending its use at the slightest sign of irritation. L. Brocq, Assoc. Ed., Annual, '96.]

(*B*) Dermatitis from Animal Irritants.—Among cases of dermatitis venenata of animal origin may be included the cutaneous inflammations caused by

the stings and bites of insects, such as bees, wasps, flees, bed-bugs, lice, and mosquitoes. The inflammatory effects vary in different persons. While in most cases the bite of a mosquito will produce simply a small, itching papule, in others, large red, painful lumps are raised, which give rise to great discomfort and often alarm. The treatment is purely symptomatic. Alkaline lotions are generally most effective. [See INSECT-BITES AND STINGS, vol. iii. ED.]

Dermatitis Medicamentosa.

Definition.—Inflammation of the skin caused by the action of medicinal agents taken into the system.

Very many medicines when administered for therapeutic purposes produce, among other by-effects, inflammation of the skin. This may find expression in erythematous, papular, vesicular, bullous, tubercular, or ulcerative lesions. No distinctive diagnostic marks can be given for these eruptions, but the occurrence of any eruption, not readily explained by other causes, should lead to an inquiry concerning the possible effect of medicines ingested. Thus, an eruption almost identical in appearance with that of scarlet fever at times follows the administration of quinine.

> [I have seen this twice in the same subject, who had already passed through an attack of scarlet fever. GEORGE H. ROHÉ.]

In the quinine eruption the high fever and sore throat of scarlatina are absent. A bullous eruption, resembling pemphigus, may follow the ingestion of iodide of potassium, which drug may also produce tubercular, pustular, and ulcerative lesions. A papulo-erythematous eruption, suggestive of measles, occasionally follows antipyrine. Copaiba may cause a macular eruption resembling the erythematous syphilide. The scarlatiniform rash of belladonna is well known. In some susceptible subjects opium preparations, in addition to itching, may also give rise to an urticarial or erythematous eruption.

VARIETIES OF ERUPTION OBSERVED AFTER INGESTION OF DIFFERENT DRUGS.—Erythematous and erythemato-papular eruptions are sometimes observed after taking belladonna, hyoscyamus, stramonium, quinine, nitrite of amyl, chloroform, arsenic, opium, turpentine, cubebs, copaiba, antipyrine, and benzoate of sodium. Sometimes these are attended with more or less severe itching, and may resemble urticaria. (See various remedies in which these manifestations occur.)

> Case of dermatitis medicamentosa diffusa following upon a dose of opium. The whole skin became red and covered with large scales. The skin was dry. Movements were interfered with on account of the pain in the skin. The epidermis was shed in large plates so as to form complete casts of the hands and feet. The normal lines of the skin were accentuated. The mucous membrane of the mouth was dry and red. The patient complained of tenseness of the skin, chilliness, thirst, loss of appetite, headache, and insomnia. Lanz (Monats. f. Prakt. Derm., No. 309, '93).

Mixed erythematous rashes (polymorphous erythema) have occurred after the administration of arsenic, quinine, digitalis, copaiba, and bromide of potassium.

Vesicular and bullous eruption may follow arsenic (herpes zoster), cannabis Indica, iodide and bromide of potassium, quinine, salicylate of sodium, and phosphoric acid.

Pustular and phlegmonous eruptions (pustules, boils, abscesses, diffuse phlegmonous or erysipelatous inflammation) have been noted after taking iodide and bromide of potassium, arsenic, quinine, hyoscyamus, opium, chloral-hydrate,

digitalis, iodide of mercury, calomel, and pilocarpine.

> [I have observed a large multinodular, tubercular eruption follow the continued use of large doses of iodide of potassium. Under the supposition that the eruption was syphilitic in origin, the dose of the iodide was increased, with the effect of aggravating the eruption. The suspicion that the lesions might be due to the iodide led to a discontinuance of the drug, when the nodules rapidly disappeared. GEORGE H. ROHÉ.]

Superficial ulcerations about the roots of the nails sometimes follow the prolonged administration of chloral-hydrate.

Purpuric extravasations have been noted after iodide of potassium, salicylic acid, quinine, chloral-hydrate, and camphor.

Treatment.—The treatment of drug eruptions must be symptomatic. The administration of the remedy must be stopped, and other indications met as they arise.

Dermatitis Herpetiformis.

Definition.—An inflammatory, superficially-seated, multiform, herpetiform eruption, characterized mainly by erythematous, vesicular, pustular, and bullous lesions, occurring usually in varied combinations, accompanied by burning and itching, pursuing usually a chronic course with a tendency to relapse and recur. (L. A. Duhring.)

The acute observations and logical reasoning of Duhring with reference to this disease have led to a general acceptance of his views on the part of dermatologists. At one time Duhring classed the disease first described by Hebra under the name of "impetigo herpetiformis," as the pustular variety of D. herpetiformis, but in his latest publication ("Cutaneous Medicine," Part II) he regards it as advisable to consider the two diseases as distinct "from a clinical stand-point, at least." Unna and Stephen Mackenzie lay stress upon the neurotic origin of D. herpetiformis.

Symptoms.—Duhring, upon whose exhaustive studies the following description is based, recognizes five varieties of the disease, namely: the erythematous, vesicular, bullous, pustular, and multiform, indicating the prevailing type of lesion present.

There is usually a prodromic febrile stage, which, however, rarely amounts to more than slight chilliness, flushing, or heat, with the accompaniments of malaise and constipation. Itching may precede the outbreak of the eruption. Any one variety of lesion may appear, or there may be from the beginning a combination of two or more of them. The type of lesion may change during the course of the disease, or, as is more rare, may remain constant throughout the attack, and may also show the same features in subsequent attacks. The subjective sensations are burning, itching, and prickling, which may be severe. In one case of the vesiculo-pustular variety, the itching and burning were most intense, relief being obtained only after the application of strong ointments or lotions of cocaine.

The *erythematous* variety occurs in patches or diffused over the surface. There is usually slight elevation of the affected skin. The red color of the eruption may be varied by a yellowish or brownish tint, and is usually followed by more or less pigmentation.

The *vesicular* variety is the most common. The vesicles are irregular in size and shape, usually tense, and rising abruptly from an apparently normal base. They may be disseminated or aggregated in groups or clusters. They sometimes coalesce to form small blebs. The itching is usually more intense than

in other forms of eruption. After the vesicles rupture there is often some relief from this symptom. Excoriation is usually not very marked.

In the *bullous* variety the bullæ are usually tense, standing out from the level of the skin. They are usually irregular in outline, differing from the bullæ of pemphigus. They are also more likely to appear in groups or clusters. Vesicles and pustules may accompany the blebs.

The *pustular* form appears pustular from the beginning. The lesions are either acuminate, discrete, up to a pea in size, or flat, not elevated above the skin, aggregated in small groups, and miliary in size. The larger pustules often have a puckered appearance.

The *multiform* variety is made up of all the various types of eruption in combination, and has suggested one of the names by which the disease is known, viz.: *dermatitis multiforme*. The lesions are macules, papules, vesicles, pustules, and bullæ of all shapes and sizes. There are excoriations and pigmentations of a brownish color. The character of the lesions is constantly changing.

Dermatitis Herpetiformis. — The course of the disease is a chronic one, and it may last, appearing and disappearing at intervals for many years. Treatment has usually little effect upon its progress.

Two cases of symptomatic dermatitis occurring in puerperal women. In the first case the eruption appeared as a papular erythema on the fifth day postpartum, while in the second it was a bright-red flush on the eighth day after labor. Wilson (Annals of Gynec. and Ped., May, '91).

Herpetiform dermatitis in pregnancy is a rare disease, little known even to obstetricians. It is distinguished by five principal characteristics: 1. A polymorphous eruption, with a predominance of bullous vesicles; simple vesicles, bullæ, pustules, erosions, crusts, and spots were met with at the same time. 2. An accompanying pruriginous disease, really painful. 3. Good general health. 4. Successive attacks of the disease. 5. A chronic character, aggravated by each attack of the disease, which may last for some years. Fournier (Jour. de Méd. et de Chir. Prat., Oct. 10, '92).

Four cases of Duhring's disease in which glycosuria was a symptom. Winfield (Jour. of Cut. and Genito-Urin. Dis., Nov., '93).

Two cases in two sisters living apart, interesting as showing family tendency, liability to onset in a predisposed person on change of climate, and general intractability of the complaint. J. J. Mooney (Med. Age, Aug. 10, '95).

Literature of '96 and '97.

Case of typical recurrent dermatitis herpetiformis, the lesions consisting of a central bulla surrounded by an areola of spreading centrifugal erythema. Between this areola and the collapsed original bulla a ring of vesicles frequently made their appearance. It is uncommon to have the lesions of dermatitis herpetiformis so closely simulating erythema multiforme. John Liddell (Brit. Jour. of Derm., p. 385, '96).

Etiology. — It sometimes begins in childhood, but most frequently between 30 and 40 years of age. There seems to be some connection between the disease and instability of the nervous system, but nothing is definitely known upon this point. There seems to be a frequent relation between the eruption and pregnancy, the puerperal state, or menstrual disturbances. The disease described by Bulkley and others as "herpes gestationis" is probably a vesicular or vesiculo-bullous form of D. herpetiformis occurring during pregnancy. There seems, also, some connection between renal defect and D. herpetiformis. It has been observed after septic infection.

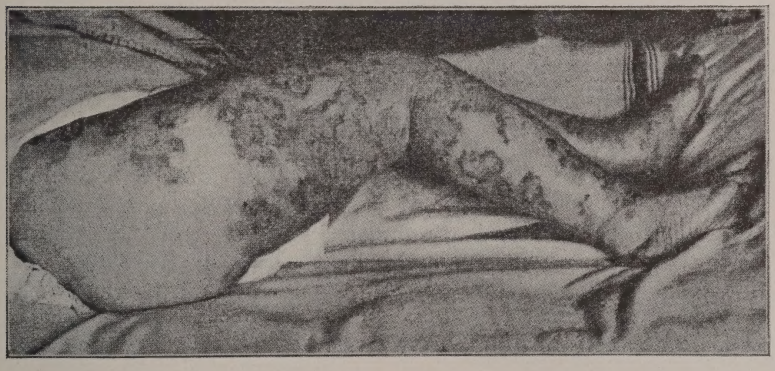
Literature of '96 and '97.

Case of dermatitis herpetiformis apparently started by vaccination: First appeared vesicles, commencing on the back of the neck, spreading almost universally. This eruption ran its course in five weeks, but was succeeded by typical, extensive dermatitis herpetiformis, lasting, with remissions and exacerbations, for four and a half years. The eruption was composed of bullæ, vesicles, and erythematous and pigmented patches, and the hands, feet, and face most severely involved; bullæ were even found on the roof of the mouth and sides of the tongue. Pusey (Jour. Cutan. and Genito-Urin. Dis., Apr., '97).

coarsely-granular type were found in the blood, the eosinophiles reaching 4.9 per cent. of all leucocytes present.

Again, when the eruption was at its height, the eosinophiles reached 12 per cent. of all leucocytes present in four specimens. The disease seems to exhibit the same features of multiformity, recurrence, and obstinacy in the natives of India as among white races. Morris and Whitfield (Brit. Jour. Derm., June, '97).

Pathology. — The pathological histology of dermatitis herpetiformis has been most thoroughly studied by Gilchrist, and the histological characters of



Dermatitis herpetiformis. (*Liddell.*)

Case of dermatitis herpetiformis in a woman of 42 with a rheumatic history. She suffered in 1895 from a stuffed-up feeling in the eyes, nose, and throat, and soon after blisters came out on the tongue; a little later on the chin; a hot bath was followed by a copious eruption of vesicles on the face and arms, which swelled greatly, and also on the chest and thighs. Fresh eruptions appeared consecutively, with soreness in the mouth, eyes, and nose, and violent paroxysmal itching and burning of the affected areas. The attacks continued, and in November, 1896, the vesicles were both discrete and confluent, and also multilocular. Considerable eosinophilia of the compound-nuclear,

the affection are shown in the illustrations on page 474, representing sections from a case of dermatitis herpetiformis (Duhring).

Fig. 1 shows two vesicles (V_1, V_2) which have been formed entirely beneath the epidermis. Macroscopically both vesicles were about the size of a small pin-head. The entire upper half of the corium is the seat of acute inflammation. *S* is a sweat-duct; *B* indicates small blood-vessels, and *G* is a sebaceous gland.

Fig. 2 shows the stage preceding the formation of the vesicles. Large num-

bers of eosinophiles (*E*) are to be seen scattered throughout the papillæ.

Fig. 3 shows the first stage in the formation of the vesicles. Immense numbers of polynuclear leucocytes are massed in the papillæ, having replaced the normal tissue.

arrangement, which Duhring regards as characteristic; the chronicity of the disease, and its frequent recurrence; the burning and itching, and general absence of marked constitutional disturbance will usually enable a diagnosis to be made without difficulty. Among the dis-

Sections from a case of dermatitis herpetiformis. (*Gilchrist.*)

Post-mortem in a case. 1. Absence of bacterial specificity in contents of bullæ. 2. Coincidence noted by Brocq of lesions of nervous system. 3. Co-existence of bullous lesions and nephritis. Gastou (Le Bull. Méd., Apr. 21, '95).

Diagnosis.—The multiformity of the lesions and the tendency to their herpetic eases which may cause doubt are pemphigus, herpes, erythema multiforme, and eczema.

Pemphigus.—The lesions are usually well-formed large blebs, rising abruptly from a normal skin, usually discrete, not attended by itching or burning, and dry-

ing up in the course of a week. Successive crops of these blebs are likely to appear.

HERPES.—The lesions are vesicular, appear upon an inflamed base, and attended by moderate pain and burning; no itching; the blisters are usually small and aggregated in groups. The course of the disease is acute.

ERYTHEMA MULTIFORME. — In this affection there are rarely vesicles, blebs, and pustules, though these may be present. The extremities are usually attacked, and the distribution of the eruption is symmetrical. The color of the lesions is a dusky red or brownish; no itching and but slight pain and burning.

ECZEMA may cause most difficulty in differentiation. The vesicles in this disease are usually easily ruptured by scratching, and the discharge of serum is abundant. Except in very acute cases, the burning sensation is not as severe as in D. herpetiformis. The scratching is followed by much more notable excoriation in eczema than in the disease under consideration.

IMPETIGO HERPETIFORMIS OF HEBRA, which was at first regarded by Duhring as merely a variety of D. herpetiformis, is now conceded by him to be a distinct disease. Its lesions are always pustular. It nearly always occurs in pregnant women, or during the puerperal period; is attended by symptoms of grave constitutional involvement, and generally terminates fatally. In some cases, prolonged observation will be necessary to make a definite diagnosis.

Lesions in herpes gestationis. Identity of two forms indisputably established by the presence, in both, of cells having special microchemical reaction, coming from the blood-vessels of the derma and eliminated by the epidermis, and by presence in the blood of eosinophilous cells. Leredde and Perrin (Univ. Med. Mag., Nov., '95).

Literature of '96 and '97.

The value of the new diagnostic sign between pemphigus and dermatitis herpetiformis first formulated by Leredde and Perrin confirmed. This consists in the simultaneous presence, in the latter disease, of eosinophile-cells in the blood and in the serum of the bullæ. In two cases examined at intervals of fifteen days the eosinophile-leucocytes and granules were found in abundance. On the contrary, in an instance of pemphigus foliaceous the eosinophile-cells were entirely absent from the blood and serum on the first and second examinations; also at an interval of fifteen days, in the blood only were found a very few eosinophile-leucocytes containing well-stained eosinophile-granules. Hallopeau and Lafitte (Ann. de Derm. et de Syph., Dec., '96).

Case resembling pemphigus and dermatitis herpetiformis, though a history of recent illicit intercourse seems for a time to have raised a suspicion, apparently erroneously, of syphilis. It occurred in a lad of 21, depressed and slightly feverish, with a profuse bullous eruption, discrete and well formed, on the lower limbs, but sparingly on the trunk, present also on the mucous membrane of the mouth. Itching was marked. In the course of two or three months the entire body became attacked. With this there was a dark-brown pigmentation, a disagreeable odor was exhaled, and the temperature was continuously above 101.5° F. No examination for eosinophiles was made. Biddle (Jour. Cutan. and Genito-Urin. Dis., May, '97).

Prognosis.—The prognosis, so far as life is concerned, is usually favorable, but the disease is generally chronic in duration, and has a marked tendency to recur. Duhring has reported cases lasting thirteen and fourteen years.

Treatment.—The treatment of dermatitis herpetiformis is far from satisfactory. In some cases the lesions yield

promptly to local applications, while in others, as Duhring states, the lesions develop, relapse, and recur from time to time in spite of the most varied measures employed. The internal treatment should be directed toward the improvement of the general health, and the ascertainment and removal, if possible, of disease or disorder of the stomach, intestines, or kidneys. The apparent close connection of the nervous system with the etiology of the disease would lead one to expect benefit from neurotic remedies, such as arsenic, phosphorus, and strychnine. Unfortunately, neither of these can be relied upon in all cases, though some show distinct improvement after the use of the first named.

Cannabis Indica, chloral, opium, and antipyrine have been tried as sedatives and anodynes; but little benefit can be expected from them.

Local applications likewise are often disappointing. Dr. Duhring has had most success—in the vesicular, bullous, and pustular forms—from a strong sulphur ointment, 2 drachms to the ounce, applied with sufficient friction to rupture the lesions. In the erythematous form soothing applications are indicated. Tar, in the form of liquor picis alkalinus, 1 drachm to 8 ounces of water, or liquor carbonis detergens of the same strength may be used with benefit in some cases. They relieve the itching, but have apparently little influence upon the progress or duration of the eruption. A 2-per-cent. ointment of cocaine is also of value as a local anodyne when the burning and itching are severe.

Ichthyol, resorcin, carbolic acid, salicylic acid, and thiol have been used, but without much success. A hot bath before retiring sometimes gives grateful relief from the subjective symptoms.

In dermatitis herpetiformis most relief gained by lotions of chloroform-water, followed by dusting with powdered talc and inunction with a calomel-and-belladonna ointment. In severe cases narcotics must be used, and, if the eruption assumes a pemphigoid character, a powder of talc with thymol may be used as a disinfectant. Dubreuilh (Revue de Thér. Medico-Chir., Mar. 1, '89).

Dermatitis Gangrenosa.

Definition.—Inflammation of the skin accompanied by sloughing or gangrene.

Etiology. — Gangrene or sloughing may follow any lesion of the skin severe enough to destroy its vitality. Thus it sometimes follows intense or long-continued pressure, severe contusions, violent inflammation, or some profound nervous disturbance. The ordinary bed-sore is an example of gangrenous dermatitis from pressure; the acute or neurotic bed-sore follows a neuritis or other disease of the peripheral nerves. In severe contusions, the application of caustics, deep burns, or frost-bite the slough is due to the sudden and violent arrest of nutrition in the part. Diabetes is not rarely accompanied by gangrene. The interesting affection known as Raynaud's disease, whose most marked manifestation is symmetrical gangrene of the extremities, cannot properly be described as a gangrenous dermatitis.

A gangrenous dermatitis of infants has been described under various names. It occurs most frequently after varicella in children debilitated by innutrition or constitutional dyscrasiæ. The lesions consist of ulcerations under a black slough of varying thickness, and occupying the site of one of the pustular or bullous lesions of the disease. The same lesion is not infrequently observed in vaccination, especially with bovine lymph. It is probable that the gangrene is due to an infection by micro-organ-

isms, but the nature of these has not been determined. This form of localized gangrene may also follow other skin diseases.

> Case of dermatitis gangrenosa infantum observed in an infant of 7 months who had suffered from purpura about the back and head. Having recovered from this, it had been attacked by small, red spots on the buttocks and thighs, with swelling of the scrotum. Two days later an ointment was applied to the sore places, which soon became raw and ulcerated. Death, which appears to have occurred from exhaustion, occurred on the thirteenth day. Punched-out ulcers of irregular shape, 1 to 1 1/2 inches in diameter, from which slough had separated, were then found. The intervening skin was red and infiltrated. Moore (Australian Med. Jour., Aug., '89).

Treatment.—The treatment of gangrenous dermatitis consists in the application of stimulant and antiseptic lotions or ointments.

Dermatitis Maligna.

Definition.—An inflammation of the skin with a tendency to malignant degeneration.

Symptoms.—The terms "malignant dermatitis" and "malignant papillary dermatitis" are applied to an inflammation, almost exclusively limited to the mammillary portion and areola of the mammary gland, and generally known as "Paget's disease of the nipple." It has much the appearance of an eczema rubrum, and is nearly always followed by epitheliomatous infiltration.

Sir James Paget, who first described the affection in a classical paper in the St. Bartholomew's Hospital Reports for 1874, gives the following account of its clinical history:—

"The patients were all women, varying in age from 40 to 60 or more years, having in common nothing but their disease. In all of them the disease began as an eruption on the nipple and areola. In the majority it had the appearance of a florid, intensely-red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed; like the surface of very acute diffuse eczema, or like that of an acute balanitis. From such a surface, on the whole or greater part of the nipple or areola, there was always copious, clear, yellowish, viscid exudation. The sensations were commonly tickling, itching, and burning, but the malady was never attended by disturbance of the general health. I have not seen this form of eruption extend beyond the areola, and only once have seen it pass into a deeper ulceration of the skin after the manner of a rodent ulcer. . . . But it has happened that, in every case which I have been able to watch, cancer of the mammary gland has followed within, at most, two years, and usually within one year. The eruption has resisted all treatment, both local and general, that has been used, and has continued even after the affected part of the skin has been involved in the cancerous disease."

The only fact that can be added to this description, after twenty-four years' further observation, is that the disease is not exclusively located upon the nipple of women, but that it may involve the nipple of the male or may occur upon other portions of the body. The inflamed patch of the nipple and areola is usually decidedly indurated, with an elevated border, and gives the sensation, when pinched up, of a button inserted in the skin.

Pathology.—It is not definitely known whether the disease is epitheliomatous from the start, or whether it begins as an eczematous dermatitis and becomes malignant in consequence of the epitheliomatous degeneration of the skin. The

glandular structures of the nipple are especially liable to malignant degeneration, and it is probable that any long-continued irritation of the epithelial elements would be followed, in persons with a predisposition to epithelial overgrowth, by malignant disease. Upon this assumption, the view that the primary disease is an eczema or a dermatitis, and that malignancy is secondary, is a rational one.

Microscopical studies of the disease by Thin and Wile have shown the epithelial infiltration present at a very early stage. It may be said, however, that when the diagnosis of malignant dermatitis or Paget's disease can be made, the trouble is no longer an eczema, whatever it may have been at an earlier period.

Literature of '96 and '97.

Case of malignant papillary dermatitis occurring on the breast of a woman of 45. The morbid changes are inflammation of the papillary layer, with œdema and vacuolation of the epidermic cells, the latter being followed by complete destruction or by abnormal proliferation in different situations. Secondary to these changes there is proliferation of the lining of the galactiferous ducts and glands. The proliferated cells finally break through the basement-membrane into the surrounding tissue, at which point malignant infection begins. F. H. Wiggin and J. A. Fordyce (N. Y. Med. Jour., Oct. 2, '97).

Diagnosis. — Diagnostic features of malignant dermatitis as differentiated from eczema of the nipple are:—

1. Its occurrence in women over 40 years of age, while eczema of the nipple is more frequent in the child-bearing age, and especially during lactation.

2. The affected surface is red, raw, and granular-looking.

3. There is decided superficial, well-defined induration in place of the diffuse, leathery infiltration of eczema.

Finally, while eczema is often obstinate, it usually yields to proper local treatment; while malignant dermatitis is not curable by any means short of cauterization or removal with the knife.

Treatment.—In reference to the treatment of malignant dermatitis, Sir James Paget said in his paper above referred to: "In practice the question must be sometimes raised whether a part, through whose disease or degeneracy cancer is very likely to be induced, should not be removed. In the member of a family in which cancer has frequently occurred, and who is at or beyond middle age, the risk is certainly very great that such an eruption on the areola, as I have described, will be followed within a year or two by cancer of the breast. Should not, then, the whole diseased portion of the skin be destroyed or removed as soon as it appears incurable by milder means?"

The answer to the question is self-evident, in view of the history of the disease. If a diagnosis of malignant dermatitis is positively made, there can be no other rational treatment than such as would be appropriate for epithelioma; namely: destruction of the diseased skin by cautery or caustics, or removal of the entire breast. In cases of doubt, the approved remedies for eczema may be tried, but too much time should not be wasted in temporizing expedients.

Pyrogallic-acid ointment, 3 drachms to the ounce; lactic acid; chloride-of-zinc paste, of varying strength; chromic-acid and arsenical pastes, the best of which is Marsden's (℞ acidi arsenosi, pulv. g. acaciæ, of each, p. e.; mix and make a stiff paste with water just before using), may all be used with good effect. Chromic acid in concentrated solution is the least—Marsden's paste the most—

painful of these applications. The arsenical paste should not be applied over a surface of more than one square inch at a time, as otherwise sufficient arsenic may be absorbed to cause symptoms of poisoning. The pain of the application is very severe, and as the caustic must remain upon the part at least twenty-four hours, the suffering is always considerable. When the paste is applied a piece of lint is pressed upon it which absorbs the surplus and prevents its spreading. After twenty-four hours, a poultice is applied, which soon causes a separation of the slough. The resulting ulcer is usually healthy in appearance and heals readily under simple applications, if all the degenerated tissue has been destroyed.

The galvanocautery and thermocautery are trustworthy methods for destroying the morbid tissue.

When the area involved is large, the best treatment is thorough extirpation of the entire breast.

Dermatitis Exfoliativa.

Definition.—Inflammation of the skin, acute or chronic, accompanied by exfoliation of the epidermis.

Varieties. — (*A*) Acute exfoliative dermatitis of infants.

(*B*) Chronic general exfoliative dermatitis.

(*C*) Local exfoliative dermatitis.

(*D*) Epidemic exfoliative dermatitis.

(A) Acute Exfoliative Dermatitis of Infants.

Definition. — An acute inflammatory affection of the skin of infants, accompanied by exfoliation of the epidermis in flakes, running a rapid course, and in most cases ending fatally.

Symptoms.—The disease was first described by Prof. Ritter von Rittershain, of Vienna. He had observed nearly three hundred cases in the course of ten years.

The children attacked were nearly all between 2 and 5 weeks old. A prodromal stage, characterized by abnormal dryness of the integument, with furfuraceous epidermal desquamation, usually occurred. The skin of the lower part of the face, especially about the angles of the mouth, becomes red and slightly tumid. The margin of the redness, which rapidly spreads, is indistinct, not being sharply defined against the healthy skin. The skin at the angles of the mouth becomes fissured and covered with scabs. The mucous membrane lining the pharynx and buccal cavity is reddened, and the palatal arch is the seat of superficial erosions, covered by a grayish-white exudation.

The appetite and digestion remain unimpaired. There is no fever. The redness and thickening of the skin extend over the entire body. The face becomes covered by yellowish, translucent scabs upon a reddened base, intersected in various directions by fissures. The skin becomes wrinkled, and the upper layer separates from the cutis. The epidermis may be detached in large flakes or in scales. This process, continuing until the entire surface is denuded of epidermis, presents an appearance similar to that following an extensive scalding. In favorable cases the dark, raw-flesh color of the cutis soon gives way to a lighter red, and in some cases the normal color of the skin is restored in twenty-four to thirty-six hours. In unfavorable cases, on the other hand, the color is a dirty brownish-red, and the cutis becomes dry and parchment-like. In those cases which terminate in recovery, the normal condition is entirely re-established in a week or ten days, the skin for a few days

being covered by a fine, branny desquamation.

As sequels, eczemas of considerable extent, or small, superficial boils and abscesses, sometimes in large numbers, occur, and delay recovery. At other times extensive phlegmonous infiltrations occupy considerable tracts of skin, and may result in gangrenous destruction of tissue and death. In the latter conditions pneumonia and colliquative diarrhœa not rarely precede the fatal termination. Relapses are rare. The disease is ascribed to a septic or pus infection localized upon the skin.

Diagnosis.—In typical cases, no difficulty should occur in diagnosis. Erysipelas, which sometimes closely resembles this disease, is easily excluded by the high temperature of the former. In pemphigus there are distinct bullæ separated by normal skin. In exfoliative dermatitis the redness and thickening are progressive and finally occupy the entire surface.

> Case of dermatitis exfoliativa pigmentosa in which the disease bore a close resemblance to the pityriasis rubra of Devergie, with the exception of the pigmentation, which was very intense. Henry Handford (Brit. Jour. of Derm., Mar., '94).

Prognosis.—This is decidedly unfavorable. In Rittershain's cases the mortality was about 50 per cent.

Treatment.—No internal treatment is indicated in uncomplicated cases. Sufficient nourishment is, of course, important. Locally, cool baths, or bran-baths, afterward drying the skin with fine, soft cloths and carefully avoiding friction, will meet the indications in most cases. Ragged and loose patches of epidermis should be clipped off with scissors, and all denuded and fissured surfaces dusted with finely-powdered calomel. The crusts which accumulate at the angle of the mouth and render nursing difficult and painful are best got rid of by soaking with oil of sweet almonds and carefully removing the loose ones by means of dressing-forceps. Slightly astringent baths (decoction of oak-bark, 1 pint to the bath) are sometimes beneficial.

> The most efficacious treatment is the creolin bath: about 15 gallons of comfortably-warm water at 95° F., to which 2 1/2 pints of a 1-per-cent. solution of creolin are added. A bath is taken regularly once a day—in very bad cases twice—remaining in it twenty minutes. It is best given at night, the patient being subsequently dried and put to bed.
>
> Creolin ointment (1/2, 1, and 2 per cent., rubbed with lanolin and water in almost equal parts) ranks next to creolin baths in efficacy, especially if used in quite an early stage. Savill (Edinburgh Med. Jour., Apr., '95).

(B) Chronic General Exfoliative Dermatitis.

Definition. — A chronic generalized dermatitis, accompanied by constant exfoliation of the epidermis in dry, papery scales: the pityriasis rubra of Hebra.

Symptoms.—The disease begins with the appearance of red patches, gradually increasing in size, uniting with others until finally the entire surface is a sheet of red, dry skin. There is no thickness or infiltration. In about a week the epidermis begins to scale off in large, thin, white or grayish scales, which soon become very profuse and shed in large sheets. The skin, at the same time becomes of a dusky- or brownish- red. The inguinal glands also enlarge. Later the skin becomes infiltrated to some extent, and looks tense and shiny in places. The mouth becomes puckered, and the skin of the joints may be fissured and sometimes moist. There may also be boils or pustules, the hair may fall out, and the nails atrophy and exfoliate. There is

often fever at the beginning and at intervals during the course of the disease. There is little itching. The subjective symptom mostly complained of is a sensation as if the skin were too small, and the patient frequently is chilly.

The course of the disease is chronic, lasting months or years, with exacerbations of greater severity, alternating with remissions.

There is usually progressive emaciation, and the patient dies of inanition, or is carried off by some intercurrent affection. Happily the disease is rare.

Case of dermatitis exfoliativa in an infant, which appeared on the tenth day of life and gradually (five weeks) spread over the entire body. It was characterized by diffuse redness, more intense in some places than in others, and by foliaceous desquamation. Small vesicles also appeared. The eruption caused itching, but did not interfere with the patient's general condition. There were no lesions in the mouth, and the hair fell in certain spots. Raymond and Barbe (Le Progrès Méd., Jan. 23, '92).

Literature of '96 and '97.

Case of dermatitis exfoliativa in a girl aged 11 years. She was first seized with fever and nausea. Three days later her tongue was heavily coated, the breath offensive, and sores were present. The face, neck, and upper chest presented a scalded appearance, the epidermis being lifted from the true skin, rolling up like tissue-paper, and being broken in a number of places. The temperature was 103° F.; the pulse 144. The disease pursued its usual fatal course, carrying off the patient two days later. No drug was held accountable for the symptoms. H. M. Beatty (Archives of Ped., Feb., '96).

The cause of chronic general exfoliative dermatitis is not known.

Diagnosis.—The only disease likely to be mistaken for chronic exfoliative dermatitis is scaly eczema. Still, this is never so universally distributed; has usually a history of moisture and exudation at some time in its course; is attended by intense itching and considerable infiltration. Lichen planus is a papular disease, and, while the papules are sometimes aggregated in solid sheets, has a different history from this disease.

Treatment.—The treatment is unsatisfactory. Arsenic, which seems indicated, has little effect on the course of the eruption. Good results are sometimes obtained from codliver-oil, both internally and externally. Saline diuretics and aperients are occasionally beneficial. Externally bland ointments may be applied. The extensive surface involved prohibits the use of mercurial applications, as salivation would be likely to follow. Glycerite of starch, or Lassar's paste may at times relieve the uncomfortable sensation of tightness of the skin.

(C) Local Exfoliative Dermatitis.

Definition.—A localized dermatitis of mild character, occurring in rounded or oval spots; rosy, red, or mottled in color, and attended by furfuraceous desquamation. It is the pityriasis rosea of Gilbert and Duhring.

Symptoms.—The most thorough study of the disease in this country is by Duhring. It begins with the eruption of small macular or maculo-papular lesions, of a rosy or reddish color, sharply defined against the surrounding skin, being sometimes on a level with it, sometimes slightly raised, and sometimes depressed. The patches are covered with fine, branny scales and spread at the margin while healing in the centre. The subjective symptoms are usually slight, only moderate itching being sometimes complained of. The disease lasts from one

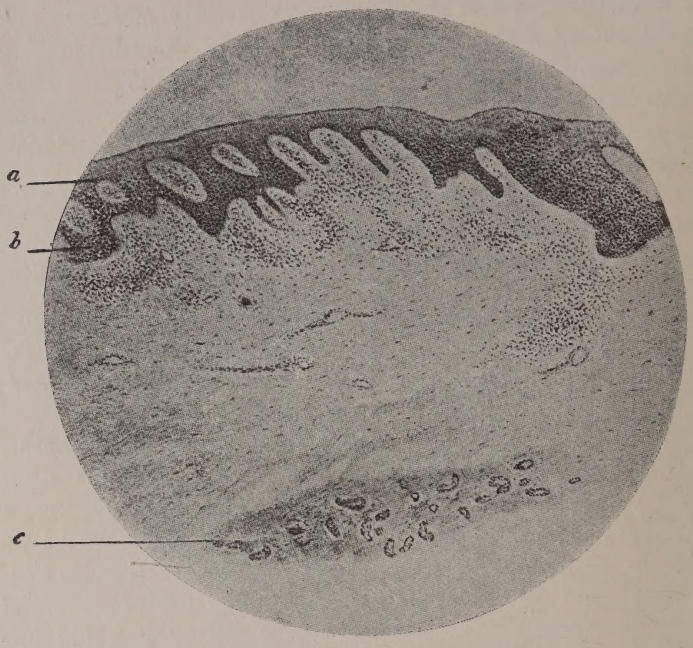


Fig. 1.

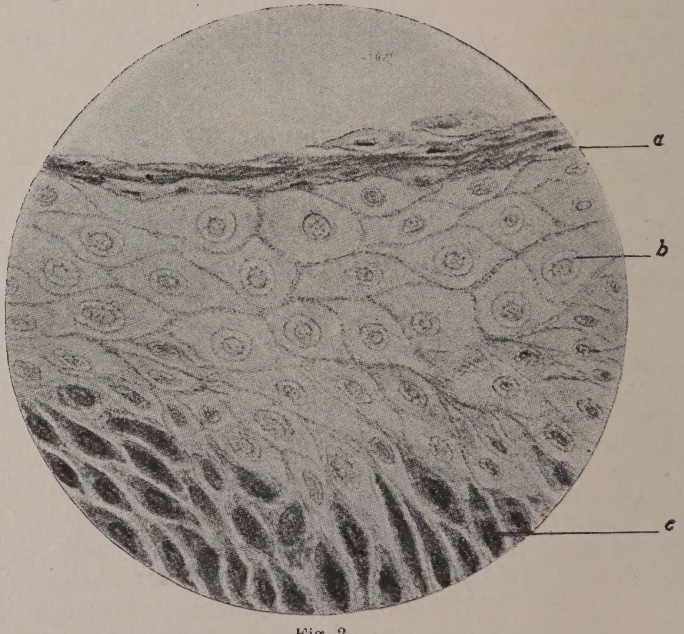


Fig. 2.

Epidemic exfoliative dermatitis : Savill's disease. (*Emilio Echeverria.*)

Fig. 1.—Low power. *a*, Clear superficial layer of epidermis; *b*, darkly-stained, deep layer of epidermis; *c*, periglandular enlargement of coil-glands.

Fig. 2.—Leitz oil immersion, $\frac{1}{18}$th. *a*, Horny layer; *b*, middle layer of epidermis, showing peridiaphania of nuclei and swelling of cell-protoplasm; *c*, lowest layer, showing hypertrophied nuclei.

General Epidemic Exfoliative Dermatitis. (Byrom Bramwell.)

to three months, recovery taking place spontaneously

Causation.—It is apparently a vegetable parasitic affection, but no characteristic parasite has been demonstrated in the skin or the scales.

Diagnosis.—The erythematous syphilide most nearly resembles this affection. The history of the case or observation of the patient for a week or two will clear up the diagnosis.

Treatment.—Lassar's paste or other mild salicylic-acid or carbolic-acid ointment may be used. Sulphur is also recommended. As the disease gets well of itself in a short time, not much attention need be given to the treatment.

(D) Epidemic Exfoliative Dermatitis. This has recently been described by Thomas Savill, of London, who observed a large number of cases in the Paddington Infirmary. The disease begins as an erythematous or papular eruption, spreading peripherally like ringworm. This is followed by exudation and desquamation. The skin is red, thickened, and indurated, the epidermis being shed in flakes or scales. There is moist exudation in most cases, especially in the flexures of the joints or behind the ears. Exfoliation is continuous.

As the disease subsides, the skin becomes brownish, indurated, and thickened, and may be smooth and shiny or cracked. The hair and nails fall. There is itching and burning, sometimes severe. Albuminuria is frequent (50 per cent. of cases). There may be fever, although this is usually not high. It is most frequent in adults, generally in those of advanced age.

Dermatitis exfoliativa is the only skin malady which, up to the present time, has been connected with epidemic causes. In some respects it resembles eczema. Distinctive points:—

ECZEMA.	EPIDEMIC EXFOLIATIVE DERMATITIS.
1. Attacks all ages, and children are very liable.	1. Children almost exempt; old people especially prone.
2. Gout is a marked predisposing cause.	2. Gout offers no predisposition.
3. Constitutional disturbance always moderate, and never fatal.	3. Constitutional disturbance often severe, and may be fatal.
4. Dried crusts thrown off, but exfoliation of cuticle not a marked feature of the disease. Dermal thickening absent or moderate.	4. Epidermal exfoliation a constant feature. It may occur in some places without previous eruption. Dermal thickening generally present.
5. Course not definite.	5. Course fairly definite.
6. Not hitherto regarded as contagious or epidemic.	6. Undoubtedly contagious and epidemic under certain conditions.

Savill (Edinburgh Med. Jour., Apr., '95).

Prognosis.—This is grave. In Savill's experience, over 12 per cent. died.

Etiology.—This is not known, though from its epidemic prevalence, apparent contagiousness, and great fatality it seems to be due to some infectious organism. This has, however, not yet been demonstrated.

Pathology. — A careful histological study of the changes in the skin has been made by Emilio Echeverria (see illustration), who concludes that the essential histological changes in the disease are superficial and to be found mainly in the epidermis. The cutis is rarely affected to any extent. According to Echeverria, the disease is rather an epidermatitis than a dermatitis. He has found a peculiar diaphanous degeneration of the prickle-cell layer of the epidermis, which he regards as characteristic.

Treatment.—Savill obtained most benefit from creolin-baths (2 $^1/_2$ pints of a 1-per-cent. solution in a bath of 15 gallons of water at 95° F.) or creolin ointment ($^1/_2$, 1, and 2 per cent.). The baths should be given once or twice a day.

George H. Rohé,
Baltimore.

DERMOID CYSTS. See Tumors.

DIABETES INSIPIDUS (POLYURIA).

Definition. — A disease characterized

by marked increase in the quantity of urine, without any important qualitative changes in the elements of which it is composed.

Symptoms.—The malady may begin insidiously; but it is not unusual for it to appear suddenly, either following one of the causes which we shall name later on, or even without any appreciable cause. It may, in exceptional cases, manifest itself during childhood or infancy.

> [I have lately had under observation a young man, 16 years old, who was subject to excessive thirst since the first months of his life. The first word he pronounced, at the age of 8 months, being "*water*." R. LÉPINE.]

When diabetes insipidus is not a primary disease, it may depend upon some nervous affection.

The urine is abundant, usually very pale in color, and is slightly acid. The specific gravity varies from 1002 to 1010. Consequently, the organic and inorganic principles are not present in any great quantity, but, taking into account the daily amount of urine, it will be found that the total quantity of organic and inorganic substances usually considerably exceeds the normal average. With regard to the relative proportions, the chlorides are increased.

In inducing unilateral polyuria in a dog, for instance, by severing a splanchnic nerve, I have likewise observed the relative increase of the chlorides. This fact proves that the relative increase results from an elective permeability of the kidney with regard to these salts.

The quantity of urine voided during the twenty-four hours naturally bears a certain relation to the quantity of liquid ingested. As the cutaneous perspiration is usually greatly diminished in diabetic patients, there is, as a rule, less difference than in the normal state, between the quantity of fluid taken and that of the urine.

It is even possible that, in exceptional cases, the quantity drank in one day may be less than that of the urine voided during the same time.

In explanation of this paradox there are three hypotheses:—

The first (which is the most natural) is the supposition that during this period the economy becomes impoverished as to water. This hypothesis agrees with several conditions sometimes noticed in polyuric subjects, particularly the increased density of the blood; in this case the weight of the patient should be less during the period in question. The second hypothesis, which, though not based on any special fact, does not seem irrational, premises that there is a much greater formation of water in the economy than in the normal conditions. In this case, there should be a diminution in the respiratory quotient: $\frac{CO_2}{O}$. It is evident that, if there is more water formed, there is less CO_2 exhaled. This fact has been observed in certain conditions of infectious fevers.

The third hypothesis appears to be less plausible. It consists in the supposition that the economy may absorb, particularly through the lungs, a certain quantity of watery vapor. It is known that in the healthy subject a copious ingestion of watery fluid is followed, during the two consecutive hours, by the loss, in the urine, of the greater part of the water taken. The same is not the case in diabetes insipidus; the elimination is less rapid, either because the kidney has partially lost its functional elasticity, which enabled it, in the normal state, to free the blood from an excess of water, or rather because the economy, being, relatively speaking, deprived of

water, takes up a certain portion of that ingested.

In the same connection it may be noted that in the polyuric subject the difference existing in the healthy person between the urine of the twelve hours of the day and those of the night is not noticeable.

Falck advanced the opinion that absorption is retarded in polyuric patients. This supposition is, in general, not very likely, but I would say that the dilatation of the stomach sometimes observed in such patients might confirm it in certain cases.

Thirst is a very marked symptom, which, in certain exceptional cases classed under the head of polydipsia, is the original symptom. This point will be again referred to under the head of DIAGNOSIS.

The digestive function is impaired in polyuric patients. This is readily understood, the digestion being disturbed by the ingestion of a large quantity of water, which dilutes the gastric juice. Constipation usually exists.

A phenomenon of some interest, theoretically speaking, has been noticed in some quite exceptional cases, namely: an abnormal flow of saliva. Külz observed this condition for a time in a young hysterical subject, and was able to collect, in one day, more than one pint of saliva.

It is known that physiologists have, during their experiments, sometimes observed salivation in dogs and rabbits, after certain lesions of the medulla oblongata, etc. In some cases the pulse is slow, and there is also a certain relation between this slowness of the pulse and the increase of the polyuria.

The blood is sometimes *more concentrated* than in the normal state, but this is by no means a constant symptom; when it exists it would seem to indicate an exaggerated permeability of the kidneys, and the inability to retain the water of the economy.

The bladder is larger than in the normal state; the kidneys may also be relatively larger, but they do not present any structural alterations.

> Case of diabetes insipidus in a young soldier whose bladder contained as much as 2 quarts, and measured 16 centimetres in height and 14 centimetres in diameter. Duponchel (La Semaine Méd., Dec. 3, '90).

Diagnosis.—This usually presents very little difficulty. The absence of abnormal principles in the urine indicates by exclusion the existence of simple polyuria. It may happen, however, that the diagnosis between this condition and that of interstitial nephritis gives some little trouble. In certain cases of the last-named affection albuminuria may not exist during a certain period. On the other hand, there are cases of polyuria in which, without any actual nephritis, traces of albumin may be found in the urine.

However, when interstitial nephritis exists, certain uræmic symptoms, hypertrophy of the heart or some one of the symptoms of Bright's disease, are always present. Besides searching for the symptoms of uræmia (cephalalgia, dyspnœa, etc.), it should also be remembered that a patient suffering from Bright's disease eliminates less nitrogen in his urine than polyuric patients, and that the urine frequently contains casts. In view of these characteristics, it is generally easy to establish a diagnosis.

Polyuria presents several varieties: primary polyuria and primary polydipsia. How are these to be distinguished?

In polydipsia thirst is unquestionably the first symptom; it is not preceded by

frequent micturition. Polyuric patients do not perspire; in polydipsia perspiration is likely to occur. In the latter affection the quantity of urine does not amount to the quantity of liquid ingested; so that, if the patient refrain from drinking during several hours, there will be, during this time, a diminution or even an arrest of the excretion of the urine.

Finally, in the polydipsic patient the blood is more rich in water, while in the polyuric it is more concentrated.

> Polyuria, frequently spoken of as diabetes insipidus, should, in many cases, be referred, not to its connection with the renal function, but to polydipsia, to which it is, of necessity, a secondary phenomenon. The diagnosis of these cases of primary polydipsia rest largely upon the following points: The existence of perspiration in spite of the polyuria, the disappearance of the polyuria after enforced abstinence from water, the fact that the amount of urine voided does not represent the entire amount of water ingested, and the fact that micturition is apparently dependent in time upon the drinking of water. Westphal (Berliner klin. Woch., Sept. 2, '89).

Etiology.—Diabetes occurs most frequently in middle age, but polyuria is not rare in childhood. In some families several polyurics will be found; these are usually families showing a neuropathic diathesis.

> Case observed in a girl, 16 years old, who suffered from diabetes insipidus, who belonged to a family in which the disease was hereditary. Four generations and 8 out of 19 members of the family had suffered from polyuria, viz.: the great-grandmother, 3 of her children, 3 grandchildren, and the great-grandchild,—the patient. The disease was, in all cases, directly inherited by the child from its parent, all the first-born being attacked. The great-grandfather suffered from enuresis, but not from polyuria. Lauritzen (Hospitalstidende, p. 353, '93).

In a certain number of cases the polyuria is referable to a traumatic cause; for instance, a fall upon the head. Sometimes diabetes mellitus immediately follows the traumatism and it is only after a time, two months or more, that it changes to diabetes insipidus. There is, consequently, an undoubted connection between the two affections. This has likewise been proved by experimentation. Claude Bernard, in puncturing a certain spot in the floor of the fourth ventricle in a rabbit, caused diabetes mellitus, while in puncturing at a slightly different point, he caused simple polyuria.

After traumatism of the cranium the chronic lesions of the encephalon, and tumors, in particular, occupy an important place in the etiology of polyuria. I have seen several cases of this kind. In one of them there was found at the autopsy a tumor of the optic thalamus. The polyuria appeared very suddenly.

Syphilitic lesions of the encephalon are the principal causes of polyuria. The number of such cases is very great.

> Case of diabetes insipidus of syphilitic origin, the third observation of the kind to be found in literature. The patient, a young man aged 25, had an extreme thirst, and passed daily about 6 quarts of urine having a specific gravity of 1004. There was no sugar or albumin present, and syphilis was not suspected till mucous patches made their appearance, ten days after admission to the hospital. One month after antisyphilitic treatment was instituted the diabetic symptoms completely disappeared, excessive hunger and thirst were no longer present, and the symptoms of syphilis disappeared, while the patient gained in weight and remained well for over a year after leaving the hospital. Suruktschi (Wratsch, p. 8, '91).

Finally, simple neuroses frequently bear a relation to this affection.

Pathology.—As to the pathogenesis, it is not unlikely that primary polyuria—not polydipsia—is caused by paralysis of the vasoconstrictors of the kidney. It is difficult to conceive of a permanent excitation of the vasodilators. There may likewise be a defect in the normal resorption of the water, which, as we know, takes place in the normal condition in the tubules; but this mechanism appears rather to be that of the polyuria attending interstitial nephritis. The health is naturally much less affected in polyuria than in diabetes mellitus; but in true polyuria the defective hydration of the tissues is likely to cause certain nervous troubles, which in themselves are of no very great importance.

Treatment.—In neuropathic subjects the general condition should be treated by means of bromide of potassium, valerian, etc. For the special treatment of the polyuria ergot of rye (or, even better, ergotine) and antipyrine should be used.

> In the treatment of true polyuria better results are obtained from the use of ergot than from any other drug. Da Costa (Med. Reg., Feb. 15, '89).

The above two remedies, the first-named, in particular, have cured the disease. I have also obtained some success by the use of the continuous current, the positive pole being placed upon the spinal column, and the negative at the level of the hilum of the kidney.

If the polyuria is dependent upon nervous lesions, the same means are to be employed.

R. Lépine,
Lyons.

DIABETES MELLITUS.

Definition.—A malady characterized by non-accidental—that is to say, a permanent or very nearly permanent—glycosuria.

Symptoms.—With but rare exceptions, the onset of this disease is insidious, and cannot be recognized by the patient. Many cases of diabetes remain entirely unsuspected until the time when some symptom other than the glycosuria attracts the attention of the patient. This may be either excessive thirst, polyuria, unusual weakness, or even impotence. More rarely, it is a sudden diminution of the acuity of the vision, or perhaps a complication in the form of anthrax or balanitis in men, and pruritus vulvæ in women. The daily quantity of urine is increased, except in some rare cases, classed under the head of "*diabetes decipiens.*"

The urine is pale in color, the reaction is sometimes unmistakably acid; the specific gravity, except in some very rare cases, is very perceptibly increased (1025 to 1045 and even 1050 has been met with). The odor is sweet, owing to the presence of glucose, which may amount to, or even exceed, 8 per cent. Generally speaking, the quantity as given by Fehling's test is a little more than that registered by the polarimeter. This is due, first, to the fact that the urine contains reducing substances which are not deviated by polarized light, and, second, to the fact that in a number of cases of severe diabetes beta-oxybutyric-acid salts are present in the urine, which deviate to the left in such a manner that a portion of the deviation of the glucose to the right is thus masked.

In mild cases of diabetes the true beta-oxybutric acid is not present in the urine; there may, however, be other substances which deviate to the left, especially levulose, which has occasionally been met with in diabetes, to the

exclusion of the glucose (Zimmer, Külz, Seegen, Marie).

Other sugars have sometimes been found; for instance, traces of pentose (Salkowski, Külz), inosite, etc.

A mixture of dextrosazone and pentosazone found in the urine of 76 out of 80 cases of diabetes. In 64 reaction positive, in remaining 12 cases doubtful. Külz and Vogel (Zeit. f. Biol., B. 32, p. 185, '95).

Literature of '96 and '97.

In 12 cases of diabetes the excretion of calcium salts was considerably increased in the severe forms of diabetes, while, in mild forms the excretion was the same, or only a little in excess of that met with in the urine of healthy persons. This increased lime excretion is due to the greater amount of food and water taken, especially to the increased amount of nitrogenous food. In those cases in which very large quantities of lime salts are excreted (1 to $1\frac{1}{2}$ grains of calcium oxide) in the twenty-four hours, the destruction of the albumin of the body is playing some part in the production of this condition. E. Tenbaum (Zeit. f. Biol., pp. 379-403, '96).

Several important chemical substances are found in diabetic urine. Next to sugar, those having the greatest significance are acetone, diacetic acid, and oxybutyric acid. E. L. Munson (Jour. Amer. Med. Assoc., May 1 to 22, June 1, '97).

Albuminuria exists in diabetes, in at least one-third of the cases, but in only a few cases is it symptomatic of Bright's disease.

One of the most common complications of diabetes mellitus is an albuminuria, doubtless in most instances secondary to the action of a urine rendered irritant by the presence of sugar upon the renal structures. In 1300 diabetics in whose urine the condition was sought for, 824 were also subjects of an albuminuria. In a large number of these cases the cause of the albuminuria is probably the excessive amount of eggs consumed in the diabetic diet, while in others the albuminuria is symptomatic of some complication, as tuberculosis, cardiac disease, renal inflammation, or a cystitis or pyelitis, depending upon the irritating nature of the sugary urine. Schmitz (Berliner klin. Woch., Apr. 13, '91).

In pancreatic diabetes albuminuria is quite exceptional; in traumatic diabetes it is a little more frequent; albuminuria is by far most frequently met with in diabetes with obesity. In grave form of albuminuria of diabetes well-marked nephritis is always found at autopsy; in the benign form but slight nephritic changes are sometimes found; more rarely no changes are detected in the kidneys. Replacement of sugar by albumin is always an extremely grave sign, but the case may not immediately terminate fatally. Jacobson (Gaz. des Hôp., Aug. 25, '94).

Literature of '96 and '97.

The frequency of albuminuria in diabetes is variable and may occur in two forms: functional and that due to grave nephritic disease. In the first form it may be extremely slight, or else may constitute a very marked feature in the case. Goudart (Jour. de Méd., Aug. 25, '97).

Owing to the polyuria, urea is naturally only present in the urine in a very small proportion, but the daily quantity of this substance is increased. Its relation to the total of nitrogen is not noticeably altered, except in grave cases of diabetes, in which the proportion of ammoniacal salts is, as is well known, greatly increased, in order to overcome the acid dyscrasia.

In serious cases the excretion of lime is also increased. Thirst is usually, but not always, predominant. Hunger is much less frequent, and a great many diabetic patients do not eat any more than a healthy person. Constipation is the rule, being either due solely to the impoverishment of the system with regard to water, or to an exaggerated tonus

of the splanchnic nerve. It may be stated, in support of the latter hypothesis, that this symptom frequently precedes the appearance of the diabetes.

The saliva is more abundant. Exceptionally it has been found to contain sugar and sometimes lactic acid. The skin is dry and perspiration is rarely modified from the normal. The blood contains a variable proportion of glucose, usually more than 3 grammes per litre, and quite frequently from 4 to 5 grammes. In exceptional cases, when the kidneys have undergone alteration, the proportion may be greater.

[I have recently seen a case in which there were more than 10 grammes of sugar per litre. R. LÉPINE.]

There is no close relation between the percentage of sugar in the blood and urine. That more sugar is excreted by the urine on certain days than on others does not depend on the fact that the amount in the blood has reached a certain quantity, but on other complex conditions. The administration of a diuretic diminishes hyperglycæmia and retards the decrease of glycosuria. Lépine (Lyon Méd., July 21, '95).

When treated by certain aniline colors, the red globules (as found by Bremer) take on a different color in diabetic patients from that assumed in other patients or in healthy subjects.

The pulse is full, but of normal frequency, except in the case of complications, when it may be rapid.

The majority of diabetics excrete more nitrogen than healthy persons of the same weight. This results from the fact that the sugar not being completely utilized, they must necessarily consume more albuminoid matter (and fatty substances), as has been proved by comparative experiments made upon a diabetic patient and a healthy subject.

[Pettenkofer and Voit formerly believed that diabetics absorbed less oxygen and excreted less carbonic acid than healthy subjects. Later on Voit formulated certain reservations upon this subject, and Leo, in an important article, affirmed that, with an equal weight in the diabetic and the healthy person, the respiratory exchanges are the same. This opinion has again been contradicted. R. LÉPINE.]

Twenty experiments upon 5 diabetics, two having a grave form of the disease, which prove that the absorption of oxygen and the exhalation of carbonic acid are not diminished in diabetics, if their weight is considered. The following are the figures obtained by causing the patients to breathe for several minutes into the apparatus of Zuntz and Geppert, the volume of gas being calculated by minutes and the kilogrammes by weight:—

	CO_2.	O.	Quotient.
First patient (grave), . .	3.21	4.01	80.0
Second patient (mild), . .	2.88	3.87	74.4
Third patient (mild), . .	3.21	2.84	81.0
Fourth patient (mild), . .	2.80	3.48	80.0
Fifth patient (very grave), .	2.84	4.27	66.5

Hans Leo (Zeit. f. klin. Med., B. 19, '92).

Hanriot, Weintraub and Laver, Ebstein, and others positively assert that, when subjected to the same *régime* diabetics exhale less carbonic acid than healthy persons.

The diminished CO_2 is the result, not the cause, of the diabetic condition; there is less CO_2 because there is less combustion of glycogen. Arnold Cantani (Deut. med. Woch., Nos. 12 to 14, '89).

The diminished elimination of CO_2, which is characteristic of diabetes, is the cause of the large sugar production, because in health the action of the diastatic ferment upon glycogen is held in check by CO_2. Ebstein (Annual, '90).

When a diabetic subject has been made to absorb a large proportion of starchy matter or sugar, the difference in the respiratory exchange between the diabetic and the healthy subject becomes particularly evident. The healthy person, soon after this ingestion, exhales a large amount of carbonic acid; in the

diabetic there are no very noticeable modifications. This important fact, added to many others, proves that the diabetic is incapable of utilizing the carbohydrates as effectively as a healthy subject.

> Views based upon experience with 1004 cases. In diabetes mellitus we have a non-combustion of carbohydrates, whether introduced from without or produced within the organism. The fact that the ingestion of sugar is always followed by its appearance in the urine at a very short interval, dispose of all theories which make diabetes the result of increased sugar production in the tissues. Diabetes consists, in the first place, in the non-combustion of some part of the carbohydrates, the excess of non-assimilated sugar appearing in the urine. As the disease progresses, a smaller and smaller amount is burned, until none is oxidized. Arnold Cantani (Deut. med. Woch., Nos. 12 to 14, 89).

Diagnosis. — A well-defined diabetes cannot be mistaken by an experienced physician. The general symptoms and the glycosuria establish the diagnosis.

Diagnosis by Examination of the Urine.—If the percentage of sugar found in the urine is considerable, doubt is impossible. If, on the contrary, a minimum quantity is found, it may be questioned whether there is not merely a condition of temporary glycosuria. This should never be lightly decided; it requires a careful watching during several days to make sure of the actual condition.

Literature of '96 and '97.

> All cases with sugar in the urine are cases of true diabetes, whether the sugar be extremely small in amount or even be entirely absent for a time. Ebstein (Centralb. f. innere Med., Nov. 21, '96).

It is in the cases in which lesions of the nervous system, and particularly of the brain, exist that the diagnosis becomes most difficult, and the common tendency to regard glycosuria as a consecutive symptom must be guarded against. The diagnosis is usually easier where paraplegia and glycosuria co-exist. It is a known fact that a neuritis of the lower members in a diabetic patient may simulate *tabes dorsalis*, but it would, however, be a rare condition when co-existing with glycosuria. The following are the differential characteristics:—

1. The walk of the patient. Were symptoms of diabetes present before the motor disturbances?

2. The symptoms proper of diabetes: the abundance of the urine and of the glycosuria, the presence of acetonuria, etc.

3. The symptoms peculiar to tabes, particularly motor inco-ordination, which is not present in diabetes; in the latter affection "steppage" exists, which symptom does not occur in tabes.

Besides these fundamental differences, there are several other signs of secondary importance, such as shooting pains, which, although they may exist in diabetes, as reported by Charcot, Raymond and Oulmont, Bernard and Féré, and others, are of sufficiently-rare occurrence. The vesical disturbances existing in diabetes have nothing in common with the vesical and urethral attacks which occur in tabes; the ocular paralysis, which is a frequent symptom in tabes, very rarely occurs in diabetes; in those cases in which there are disturbances of vision, an examination of the fundus will dispel all uncertainty: in diabetes retinitis will be found; in tabes atrophy of the optic nerve. If the latter lesion is not sufficiently pronounced to be recognizable, it should be remembered that in the amblyopia of diabetes the optic disturbance is bilateral from the

beginning, while in tabes it most frequently begins in one eye.

The above refers to the diagnosis between diabetes and glycosuria of nervous origin; but the latter variety is not the only one which may be mistaken for diabetes. I will first refer to alimentary glycosuria, which occurs in certain subjects after a very copious ingestion of the hydrocarbons; it also occurs in nearly every subject after the ingestion of a sufficient quantity of glucose during a short space of time (*at least* 200 to 300 grammes for certain persons). Alimentary glycosuria was first observed in certain cirrhotic subjects by Cotrat, afterward by myself and a number of others (Quincke and others), but the affection is not best seen in cirrhotic patients. Krauss and Ludwig observed a young girl suffering from Basedow's disease who, after the ingestion of from 100 to 200 grammes of pure glucose, excreted very nearly 17 per cent. of the glucose ingested.

Chvostek, at Meynert's clinic, was also able to produce alimentary glycosuria with great facility in patients suffering from Basedow's disease. Evidently these patients, owing to their nervousness, are particularly predisposed to glycosuria. In some subjects, on the other hand, it is almost impossible to induce alimentary glycosuria.

The glycosuria which sometimes follows certain acute maladies, and some surgical affections and cases of poisoning, cannot well be mistaken for diabetes, as the other existing conditions would arouse the attention of the physician. Moreover, this form of glycosuria is always very mild.

Case of myxœdema in which the ingestion of thyroid tablets caused glycosuria. Ewald (Deut. med. Zeit., No. 60, '94).

Under fresh thyroid-gland diet animals are affected with tachycardia, considerable emaciation, polyphagia, polydipsia, and temporary glycosuria. Georgiewski (Centralb. f. die med. Wissenschaften, No. 27, '95).

Marked polyuria with glycosuria is produced in animals by caffeine-sulphonic acid. Jacoby (Archiv f. exper. Path. und Pharm., B. 35, H. 2, 3, '95).

Chloralamid, $1\frac{1}{2}$ to 3 drachms per day, frequently causes glycosuria. Manchot (Virchow's Archiv für Path. Anat. und Phys. und f. klin. Med., B. 136, p. 368, '95).

This is not always the case when the glycosuria is due to the ingestion of phloridzin.

Phloridzin diabetes appears more intense when the liver contains no glycogen. Pick (Archiv f. exper. Path. und Pharm., B. 33, p. 305, '95).

It is known that the proportion of glucose contained in the urine may be as great as in very severe diabetes; consequently, there are only two ways to avoid being deceived by a patient who hides the fact of having taken the phloridzin. The patient must be closely confined and be deprived of phloridzin. On the other hand, the blood-corpuscles must be carefully examined for the reaction of Bremer (see farther on). In cases of phloridzic glycosuria, this reaction will not be present, or, in the worst case, will be exceedingly doubtful.

Since the works of Blot it is known that sugar is frequently present in women during parturition.

Diabetes is a rare complication of pregnancy. Study of one personal case, and twenty-four reported by other observers. About one-half of these acquired diabetes during pregnancy, the other half already having the disease before pregnancy occurred. In the former class recovery took place in about three-fourths, with, however, an exhibition of a tendency to recurrence in subsequent pregnancies. In the class in which pregnancy occurred in women

already subjects of diabetes, safety through delivery and the lying-in period was apparent in about two-thirds of the cases. Death of the fœtus is noticed in about one-half of the cases. Premature delivery is observed in a large proportion of the reported cases, due to the presence of the dead fœtus rather than the direct influence of diabetes. There were 6 deaths in coma or collapse during or near the time of labor: 1 in a woman who had diabetes before gestation, while 5 were in patients who acquired the disease during pregnancy. Partridge (Med. Rec., July 27, '95).

Forty-six women examined, 9 of whom were pregnant, 25 delivered, and 12 nursing. In pregnancy in the last month no trace of sugar was observed; in 10 women recently delivered the presence of sugar was positively ascertained; in 3 cases but slight traces were found, and in 12 others there was no sugar present. The glycosuria appeared about from three to five days after delivery, during the increased secretion of milk, disappearing when the secretion diminished. No glycosuria was observed in nursing women. The condition appears only when the secretion of milk is in excess of that required for the child. Berberoff (Wratsch, No. 16, '93).

It may be necessary in some cases to question the existence of a true diabetes. To establish the diagnosis, reliance may be placed upon the fact that, in the case of a false diabetes, the secretion of milk is always arrested, and that the sugar contained in the urine is not glucose, but lactose, which fact has been established by Hofmeister, and, after him, Kaltenbach. It would appear, however, according to Blot, de Sinéty, and several more recent observers, that the lactose may be partially transformed into glucose; so that the presence of a fermentable sugar (glucose) in the urine of a parturient woman would not incontestably prove the fact that the patient was a diabetic. I may here call attention to the fact that Mathew Duncan found true diabetes in a pregnant woman. The child was also said to be a diabetic!

A gross error committed by inexperienced persons consists in regarding a subject diabetic whose urine reduces cupro-potassic fluid, but which, in reality, does not contain a trace of sugar. This error is the more regrettable through the fact that the restriction to an animal diet may aggravate the condition of the patient instead of improving it, for the animal diet favors the production of reducing substances in the economy. Among these substances are uric acid, creatinin, allantoin, mucin, oxyphenol, pigments, and above all the components of glycuronic acid.

How is this error to be avoided?

1. In non-albuminous urine deprived of the greater part of its uric acid by a preliminary cooling (on ice) and by filtration, the existence of sugar may be admitted if the reduction of the cupro-potassic fluid takes place in the cold state, as the reducing substances only exert their action at the boiling-point. Sugar, itself, in the cold state, only causes a reduction at the end of several hours.

If one does not wish to wait, recourse may be had to the following process, which is a modification of that proposed by Worm-Mueller, to determine whether the reduction by heat is partially due to a small quantity of sugar. The exact quantity of urine required to discolor 1 cubic centimetre of Fehling's solution must first be determined, then a portion of the same urine is fermented; this being accomplished, it must then be ascertained whether a greater number of cubic centimetres will be required to discolor the same quantity of Fehling's solution.

It is clear that, if a larger quantity

is required, a portion of the reducing power was due to a certain quantity of sugar. This method is exact, and its only defect is that it is not within the reach of the ordinary practitioner, owing to the precision of the dosages required.

To lessen the error due to the reducing substances, it has been advised to dilute the urine to the fifth and even the tenth degree. Indeed, this should always be done when the urine is very highly charged with sugar; but when there exist only doubtful traces of it, the dilution of the urine is a positive means of not being able to obtain the sugar. This process should consequently be rejected.

On the other hand, the following method, which is, moreover, a classical one, is perfectly reliable. About 4 grammes of Fehling's solution are poured into a tube; it is heated to the boiling-point, then one to two centilitres of urine, non-albuminous, which is supposed to contain sugar, should be made to flow along the side of the tube, which should be inclined. It is well to first heat the urine slightly; otherwise the inclined tube should be held above a flame for several moments in order to sufficiently raise the temperature at the point of contact of the two liquids. After a few moments, if sugar is present, a green ring will be seen to form, which will then rapidly change to yellow, and afterward to red, which will contrast decidedly with the blue color of the subjacent liquid. This reaction is easily accomplished, and, if a red ring is obtained, it is of great value, for the reducing substances only produce hydrate of oxydule, which is of a yellow color.

Jastrowitz recently advised examination, by means of the microscope, of the precipitate of oxide of copper. As a matter of fact, none of the reducing substances, uric acid, creatinin, nor the components of glycosuric acid, etc., produce a crystalline precipitate. According to the author, these crystals are tetrahedral and octahedral. These are actually the forms obtained when a watery solution of glucose is made to react upon Fehling's solution, but, according to Jastrowitz, small spheres may also be produced with urine containing a slight amount of sugar. Thus, when, under the microscope, these (spheres) predominate, provided they are accompanied by tetrahedral and octahedral crystals, it may be affirmed that sugar is present in the urine.

It is possible to partially rid one's self of the reducing substances, by means of a process described a long time ago by Leegen, and which is to be recommended on account of its simplicity. The urine is filtered through animal charcoal as many times as are necessary to discolor it; then the charcoal is washed in distilled water, and the two filtered liquids—viz.: the urine and the distilled water—are treated separately by Fehling's solution.

The reason is as follows:—

The charcoal not only retains the coloring matter and the uric acid, but likewise certain substances, as yet not well known, which prevent the precipitation of the oxide of copper. Therefore we are better able to search for the sugar with the filtered water than with the urine. Furthermore, the charcoal has retained a large portion of the sugar contained in the urine, and gives off into the distilled water a larger portion of the sugar than of the other substances which it had retained. Consequently the reduction of Fehling's solution is much more easily accomplished by this water than by the urine.

These are the advantages of Seegen's method, by means of which the author is able to discover a one-thousandth part of sugar in the urine. Even with a smaller proportion there will be a reaction, but this will only become apparent, says Seegen, after several minutes' heating. No other method surpasses this in sensitiveness, and it is most easy of application, *provided a perfect animal charcoal is at hand.*

To summarize what I have already stated in the beginning, Fehling's solution, provided one knows how to use it, is capable—all statements to the contrary notwithstanding—of alone determining the existence of sugar. The reducing action of glucose upon the oxide of bismuth in the presence of an alkali has also been resorted to for a long time. This reaction, called that of Böttiger, which is described in all the treatises on urology, is far from being valueless, especially when made use of with the modification indicated by Nylander.

Leaving aside several other reactions, which have not come into general use, because they are not sufficiently accurate, I pass on to the reaction of phenylhydrazin, described by Fisher, and employed by von Jaksch for the discovery of glucose in the urine. This reaction is based upon the property, peculiar to phenylhydrazin, of forming, when in combination with glucose, a crystalline substance of a decidedly-yellow color.

Jaksch obtains this reaction as follows: 10 cubic centimetres of the urine to be tested are poured into a tube, adding three pinches of the acetate of soda in crystals, also two pinches of hydrochlorate of phenylhydrazin. The mixture is placed for a time in a water-bath. After it has cooled a yellow, crystalline deposit is formed, which, under the microscope, appears to be composed of fine needles, some isolated, others in bunches, and some assuming star-formations.

It has been said that this reaction is not absolutely characteristic, and that glycuronic acid will also cause needle-formations; but Hirschl has ascertained that by leaving the tube one hour in the water-bath the glycosuric components do not give rise to a crystalline precipitate, and Binet, who has made a very complete study of this important reaction, considers it as absolutely reliable with the following slight modifications:—

Ten cubic centimetres of the urine to be examined, deprived of albumin, are taken and cleared by means of a few drops of an acetate-of-lead solution. It is then filtered, and a few drops of acetic acid, three pinches of acetate of soda, and two of hydrochlorate of phenylhydrazin are added. The whole is left in the water-bath for one hour. The tube is then allowed to cool, and on the following day the urine is examined with a very powerful magnifying-glass. Under these conditions no balls or granular masses are found, but yellow or silvery crystals, characteristic of phenylglucosazone. According to Binet, by proceeding in this way, one two-thousandths of sugar is distinguishable—an exceedingly small proportion. The reaction, which is absolutely correct, is, therefore, an extremely-sensitive one.

I do not believe that fermentation surpasses it in this respect. Beer-yeast alone, and likewise the urine itself, when left undisturbed, give rise to some gas-bubbles. Thus, in order to arrive at the certainty of the existence of the sugar, a test experiment must be made. Two similar test-tubes are prepared, the suspected urine is placed in one, and normal urine in the other, an equal quantity of yeast is added to each one, and they are

left under the same conditions during twenty-four hours.

One thousand specimens of normal and pathological urine examined with the view of ascertaining whether traces of sugar must be looked upon always as pathological. Using the phenylhydrazin and the fermentation tests as the most delicate tests for sugar, 58 per cent. of the analyzed urine showed no trace of sugar; traces of sugar cannot, therefore, be looked upon as normally present in the urine.

Of the tests which, in doubtful cases, prevent the possibility of a mistake, the phenylhydrazin test must be cited. The only drawback of the test is the formation of crystals similar to the phenylglucosazone crystals, if glycuronic acid be present in the urine. However, the microscopical appearance of the two sets of crystals is sufficiently distinctive. The phenylglucosazone crystals occur in the form of bundles of long needles and of separate needles; the crystals of glycuronic acid appear in the form of rosettes, the needles are thick and plump, and the whole resembles the crystals of ammonium urate. The delicacy of the test is interfered with in albuminous urines and in urines which are concentrated or rich in urates. A. Jolles (Centralb. f. klin. Med., Nov. 3, 10, '94).

Glucose is not a normal constituent of the urine; high specific gravity does not always indicate the presence of sugar; not infrequently concentrated urines with a specific gravity of 1028 to 1032 contain no sugar; small quantities of sugar influence the specific gravity very little. Trommer's and Worm-Mueller's tests are confusing. In the Fehling-Wendriner test results did not always agree. Hoppe-Seyler's test with alpha-nitro-phenylpropionic acid is not adapted as a single test. Its delicacy lies at about 0.4 per cent. Jolles (Amer. Med.-Surg. Bull., July 5, '95).

Literature of '96-'97-'98.

In two clean and dry test-tubes 10 cubic centimetres of normal and diabetic urine, respectively, are placed; 0.5 milligramme or less of finely-rubbed-up gentian-violet is then allowed to drop on to the surface of the urine. In diabetic urine the superficial layers of varying depth are colored blue or violet-blue, and this color does not disappear on shaking. In normal urine, even after shaking, no color, or only the faintest trace, is developed. Merck's gentian-violet B is the best. In low temperatures the reaction is not so marked. The addition of mineral acids or sugar to normal urine will not lead to the development of this color reaction, which is really due to the presence of reducing substances in the diabetic urine. Bremer (Centralb. f. inn. Med., Apr. 2, '98).

To 10 cubic centimetres of the urine are added 5 cubic centimetres of a concentrated solution of neutral lead acetate, and then, after shaking, 5 cubic centimetres of basic lead-acetate solution. When the whole is filtered, an almost clear colorless fluid should be obtained. Then equal parts of the filtrate and a watery solution of methylene-blue (0.3 per cent.) are placed in two different test-tubes, and to the tube containing the methylene-blue is added 1 cubic centimetre of a 10-per-cent. caustic-potash solution for each 5 cubic centimetres, so as to make it strongly alkaline. This latter tube is then heated over an open flame, and the contents of the other tube are poured into it, and the whole boiled. If sugar is present, the dark-blue color is changed to a whitish one; the solution then becomes transparent, and finally a pale yellow. The lowest limit lies at about 0.04 to 0.05 per cent. of sugar; the reaction with a urine containing 1 in 1000 sugar is slow. Frölich (Centralb. f. inn. Med., Jan. 29, '98).

To recapitulate, Seegen's method with Fehling's solution, the phenylhydrazin reaction, and fermentation are the three methods capable of recognizing with certainty the presence of a small quantity of sugar. The first is by far the most rapid. The phenylhydrazin requires at least two hours and the fermentation test twenty-four hours.

I have yet to refer to certain very rare cases in which, although the urine responds to Fehling's test and becomes brown by the addition of caustic potash, it does not actually contain sugar, but instead alcaptone. In these cases there is no polarimetric deviation nor any alcoholic fermentation.

THE DIAGNOSIS OF DIABETES BY MEANS OF THE BLOOD.—Bremer, as we have already mentioned above, has found that the red corpuscles of diabetic blood cannot be stained with aniline colors in the same way as the blood-corpuscles of the normal blood. The latter are distinctly acidophilous, while in the diabetic blood they become basophilous; they no longer take up eosin, the preferred color of the normal blood-corpuscles.

This reaction, which Bremer has subjected to several variations, is of great importance in cases in which a diabetic patient, who has no actual sugar in his urine, wishes to conceal his disease from the physician of an insurance company. It is important to know, however, that this reaction is, as Bremer has stated, independent of the glucose, not pathognomonic of diabetes. It may, also, take place in the corpuscles of leukæmic blood. (Lépine and Lyonnet.) See COMPLICATIONS.

Etiology.—Statistics referring to thousands of cases show that diabetes is most prevalent between the ages of 50 and 60 years.

> Age is usually regarded as a factor in the etiology, and, according to a personal analysis of 2115 cases, the period of its greatest frequency extends between 30 and 60 years of life (the greatest number fall between 50 and 60 of any of the decades). Diabetes mellitus prevails to a much greater extent in some localities than in others; for example, in Malta it is a scourge of greater severity even than tuberculosis is in Germany. It is common in Sweden, and very frequent among Jews, wherever they may live. Schmitz (Berliner klin. Woch., July 6, '91).

It is probable, however, in view of the difficulty frequently experienced in determining the exact onset of the disease, that it often begins before the age of 50. The disease is relatively rare in childhood. No cases were known in which the disease existed in early childhood until very recently (during the past few years), when several cases have been published.

> One hundred and seventeen cases in children collected. The disease is not near so rare in children as has been commonly supposed. As to sex, of the 117 cases, 47 were females, 31 males; of the remainder, the sex was not determinable. The proportion of males to females was 5 to 3. As to the age itself, 6 were found under 1 year, 1 seeming to be born with it, as it was noted a few days after birth; 7 were over 1 year, 3 over 2 years, 7 over 3 years, 6 over 4 years, 5 over 5 years, 1 over 6 years, 6 over 7 years, and 2 cases had completed 8 years; 8 were 9 years old, 6 were 10 years, 9 were 11 years, 8 were 12 years, 9 were 13 years, 5 were 14 years, 4 were 15 years old. Of the remaining 28 the age was not given. The children appeared generally of the better class. As to the etiology, heredity was conspicuous, since the parents were often diabetic. Next to heredity, previously-existing disease was found, the most frequent cause was notably gastric catarrh. C. Stern (Archiv f. Kinderh., B. 11, H. 2, '89).
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> The urine of 50 nurslings between the age of 1 day and 4 weeks examined. This number included 24 healthy children, 1 premature child, 1 case of hydrocephalus, 14 cases of acute and chronic gastro-enteritis, and 10 cases of other forms of dyspepsia. Among the 50 cases the urine of 10 caused a reduction of Trommer's test with cupric sulphate. In 2 cases the results were confirmed by observations made with the polarimeter. These 10 cases included 7

of aggravated gastro-enteritis which terminated fatally, and 3 of mild dyspepsia. Grösz (Pester Med.-Chirurgische Presse, No. 37, '92).

It appears upon a study of 108 cases of infantile diabetes that children of both sexes seem to be affected in an equal proportion, and that the disease is most frequently observed about the age of 5 years. As a cause, traumatism was found in 11 cases; dentition, chill, excesses of various kinds, rapid growth, insufficient food, violent emotion, or sorrow in others. Wegeli (Archiv f. Kinderh., B. 19, H. 1, '95).

Case in a child 18 months old. No disease or likely cause. A fall of 1 1/2 feet possible origin. Jaworski (Med. Press and Circular, July 17, '95).

Literature of '96 and '97.

The patient is the first child, a girl 2 1/2 years old. The parents are healthy; no diabetes has occurred in their families. The urine was a light yellow; daily quantity, 2 litres; sp. gr., 1029; 52 per cent. of sugar present; diacetic acid; no albumin.

Diabetes mellitus is a rare disease at this age; six cases found under 2 1/2 years of age in 110 cases collected. L. Rosenberg (Wiener klin. Woch., x. 487, '97).

Men are much more likely to be attacked by diabetes than women. In childhood sex has no influence.

Out of 1004 cases of diabetes, 837—or 83.37 per cent.—were males, and 167—or 16.63 per cent.—were females. A. Cantani (Deut. med. Woch., Nos. 12 to 14, '89).

Literature of '96-'97-'98.

The proportion of males and females in the white race who suffer from diabetes is about 3 to 2. In children, however, the ratio is not the same; girls have it more frequently than boys. In the colored race the cases occur more frequently in women than in men. Futcher (Johns Hopkins Hosp. Bull., Feb., '98).

The frequency of diabetes varies very much in different countries.

Literature of '96 and '97.

In Danish cities the mortality from this disease has almost quadrupled itself during the last thirty years. In Paris, between the years of 1865 and 1873, only 2 to 3 in each 100,000 died annually from diabetes. By 1892 the numbers had risen to 13 in 100,000. The disease is exceedingly common in India, in Russia it is very uncommon, and in Normandy it is wide-spread. Lépine (Rev. de Méd., '96).

In the absence of sufficiently-reliable statistics, it is preferable to abstain from giving any figures. In the same country different races are very unequally affected, and on this point, also, it is necessary to await further researches. A fact which may be positively stated at present is the relative frequency of diabetes in the Jewish race.

In Frankfort-on-the-Main 171 persons died from diabetes during a period of nineteen years. Of 156 of these cases, 51 were Jews and 105 belonged to other denominations. The mortality from diabetes is six times as great among Jews as in other religions. Wallach (Deut. med. Woch., Aug. 10, '93).

Diabetes is frequently hereditary, inasmuch as several members of one and the same family are frequently affected with the disease; but the heredity is seldom direct.

The diabetic predisposition is hereditary. In 998 cases out of 2115 it was discovered positively that there were, or had been, 1 or 2 cases of diabetes among their blood-relations, and in some cases more. Schmitz (Berliner klin. Woch., July 6, '91).

It has been justly remarked that these diabetic families are tainted with the uric-acid diathesis, and that obesity, gout, and neuropathic affections exist in extraordinary frequency in such families. Frequently obesity and diabetes co-exist in the same person. A too exclusively-starchy diet and the abuse of wine and

ciders are predisposing causes of diabetes.

In the canton of Zurich diabetes is rather rare, but 23 cases being recorded among 33,424 dead of all causes in a space of five years. The disease seems to be somewhat more frequent in the poorer classes, 6 cases out of 1000 dispensary patients being met with. Leva (Deutsches Archiv f. klin. Med., B. 36, H. 1, 2, '91).

In 200 cases there were found 4 intemperate, 107 temperate, 89 total abstainers, 69 opium *habitués*. Mitra (Indian Med. Record, June 1, '95).

In 607 persons engaged in manual labor or requiring great muscular and respiratory activity, no sugar was found in any case; in 100 persons engaged in intense intellectual work, sugar was found in 10. Worms (Bull. de l'Acad. de Méd. de Paris, July 29, '95).

Diabetes appears more frequently in March, April, July, and November; increased mortality in winter, but not in relation with average temperature. Davis (Amer. Jour. of the Med. Sciences, July, '95).

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The increase of diabetes is much more pronounced among the wealthy classes than among the poor, the average in the poorer parts of the city being only 7 to 9 in 100,000, while in the wealthy quarters the average is 16 to 20. Bertillon (Editorial, Modern Med. and Bact. Rev., Apr., '97).

The causes which we have so far mentioned are *predisposing* causes.

As to efficient causes of diabetes, acute infectious diseases cannot be considered in this category, for the affection does not come on after typhoid fever, eruptive fevers, etc. With regard to malaria, several French physicians have noted a temporary glycosuria after attacks of intermittent fever; but in malarial countries true diabetes does not appear to be any more common than elsewhere.

The question of syphilis will be referred to later.

The part played by contagion in diabetes is, so far, not based upon any very exact observations. The occurrence, said to be quite frequent, of diabetes in husband and wife, has been a mooted question.

Man and wife may both be diabetic. From an analysis of 2320 cases, 26 examples of such occurrence have been accumulated. Quite healthy persons, without hereditary predisposition, may become suddenly diabetic after attending to a diabetic for a time, living in the same room, sleeping with and especially kissing him often. In the light of these data, embodying somewhat over 1 per cent. of several thousand cases, the possibility of an infectious nature in diabetes mellitus is strongly suggested. Schmitz (Berliner klin. Woch., May 19, '90).

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Twenty-six examples recorded where husband and wife both suffered from diabetes. These were examples chiefly of married females who had become suddenly diabetic after nursing a diabetic husband. There was no indication of hereditary predisposition. No family relationship between the patients, no excess of sugar taken in the food, and the patients had not suffered from gout. The question raised of the possibility of contagion or transmission of the disease.

The numerical relation between diabetic married couples and other diabetic cases is shown in the following table:—

	Married Diabetics.	Total Diabetics.
Betz	1	31
Hertzka	1	86
Lecorché	6	114
Schmitz	26	2320
Seegen	3	938
Külz	10	900
Totals	47	4389

or 1:93 $^{3}/_{8}$, or 1.08 per cent. B. Oppler and C. Külz (Berliner klin. Woch., Nos. 26 and 27, '96).

Among 770 cases of diabetes observed there have been 9 instances of man and

wife suffering from the disease: 1.19 per cent. When all the cases are excluded in which there is a family history of the disease, or a history of any of the well-known etiological antecedents, the cases remaining are so few that it seems probable that the occurrence is accidental, or that both man and wife have been subjected to the same antecedents. H. Senator (Berliner klin. Woch., July 27, '96).

In a series of 5000 cases 1.8 per cent. of conjugal diabetes found. The facts thus far published do not shed much light on the two theories of causation now held, viz.: (1) that the ordinarily-accepted causes of diabetes are active in both husband and wife, and (2) that the disease is contagious. Cases have been reported with almost conclusive evidence of contagion, but the nature of the contagion and how it is conveyed are mysteries. Schram (Med. News, Jan. 1, '98).

This coincidence, if it actually is of frequent occurrence, would be an argument in favor of contagion. The question is now being studied.

Nervous affections are certain causes of diabetes. The disease is often met with in people who have suffered from much anxiety or worriment.

Diabetes should be classed among the neuroses; its varied phenomena result by reflexes from the nervous system. The disease obviously arises in the sympathetic chain which controls the secretory functions of the kidneys. J. Blake White (Amer. Medico-Surg. Bull., '95).

Diabetes also occurs very frequently where there has been traumatism of the head. According to certain statistics, 20 per cent. of all cases of diabetes are due to this cause. It is possible that this proportion may be exaggerated, but I am willing to admit that there is surely *one* case of traumatic diabetes in thirty diabetic patients.

The traumatisms most often followed by diabetes are those affecting the head (25 in 45); sometimes also those affecting the vertebral column. Cerebral disturbance mentioned twelve times. Sugar does not always appear in the urine immediately after traumatism; if the diabetes succeeds rapidly to traumatism, it is almost always mild; on the contrary, almost all the uncured cases of traumatic diabetes begin late. Progress is at times rapid; radical cures have been observed fairly often (14 cases out of 45), but they seldom take place where diabetes has persisted more than six months or a year. Bernstein-Kohan (Thèse de Paris, '91).

Review of 212 cases of traumatism of the head admitted into the Boston City Hospital within thirteen months. Ranged in five classes: (1) wounds of the scalp; (2) wounds with denudation of the bone; (3) commotion, including cases followed by loss of consciousness, but without fracture; (4) fracture of the vault; (5) fracture of the base. Of the first class there were 84 cases, 5 of which, or 6 per cent., presented glycosuria; in the second class, 43 cases, 4 with glycosuria,—9 per cent.; third class, 40 cases, 1 with glycosuria,—2.5 per cent.; fourth class, 24 cases, 5 with glycosuria,—20.8 per cent.; fifth class, 21 cases, 5 with glycosuria,—23.8 per cent. In all, 20 cases of glycosuria in 212 cases. F. A. Higgins and J. B. Ogden (Boston Med. and Surg. Jour., Feb. 28, '95).

Since the time of Claude Bernard we are aware of the fact that lesions of the floor of the fourth ventricle are particularly liable to give rise to diabetes. Several cases have been observed in man. Lesions in various parts of the encephalon may bring about the same result. It is extremely probable that syphilis is not a cause of diabetes, except through the influence of diffuse lesions of the nerve-centres. There is consequently no syphilitic diabetes, but a diabetes dependent upon cerebral lesions, whether due to syphilis or any other cause.

Out of twenty-seven records of examination of the brain in cases of diabetes mellitus, the organ normal in but five

instances, the abnormalities consisting most frequently of œdematous brains with thickenings of the membranes. Less frequently the organ was anæmic, cystic, particularly in the frontal lobes, in the pons, and in the medulla. Careful examination with the microscope failed to indicate any histological changes, except in one instance where the capillaries of the vagus nucleus seemed to be abnormally numerous and full of blood. Saundby (Med. Chronicle, Jan., '90).

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Two cases of diabetes, in which changes were found in the spinal cord.

In the first case on naked-eye examination of the spinal cord, after hardening in Müller's fluid, degeneration was found in the posterior columns. This was most marked in the cervical and lumbar enlargements. In the lower cervical and dorsal regions the lesion was confined to Goll's columns; above and below it extended laterally into Burdach's columns. The sacral region was unaffected. In the lower dorsal region the right posterior column was distinctly more markedly affected.

In the second case degeneration of the posterior columns was also found. It was limited to Goll's columns in the upper cervical region. In the lower cervical region it spread to Burdach's columns, and was most extensive in the lower cervical and middle dorsal regions. Below the lumbar enlargement the degeneration ceased.

The spinal changes regarded as the result of the action of some toxic substance in the blood of diabetic patients. Similar changes have been found in the posterior columns of the spinal cord in pernicious anæmia, leucocythæmia, Addison's disease, etc. E. Kalmus (Zeit. f. klin. Med., B. 30, H. 5, 6).

Relationship between diabetes mellitus and epilepsy. Cases in which the diabetes is the cause of the epileptic attacks may be divided into two categories, according as the attacks are due to cerebral lesions or to disturbance in the intra-organic exchange consecutive to the glycosuria. Cases belonging to the former group are rare. In the cases of epilepsy due to diabetes the convulsive spasms are determined by toxic products of intra-organic exchange, and take more or less the form of coma. The acetonæmic diabetic epilepsy rapidly leads to fatal coma, but when it develops in a chronic and intermittent manner is said to determine epileptic seizures. The cases in which diabetes seems to depend upon epilepsy are divisible into two clinical varieties: those in which the elimination of sugar merely follows the convulsive attack—these have rarely been found; and those in which the glycosuria is a more or less constant accessory symptom of the epilepsy. The cases in which diabetes and epilepsy appear simultaneously are of two kinds: 1. Epilepsy often alternates with diabetes and mental disorders in neuropathic families, and it would, therefore, not be a matter of surprise to find the two conditions present in one person of such a family. 2. There may be a predisposing cause of both in the same subject.

A case belonging to this latter class. The patient had an apoplectic stroke resulting from ischæmia of the left hemisphere due to a cardiac lesion. There was aphasia and pollakiuria, but no polydipsia, polyphagia, nor polyuria. Some months later epileptic seizures, with complete loss of consciousness and convulsions in the previously-paralyzed half of the body, supervened. Ebstein (Sem. Méd., May 22, '96).

The pancreas is very frequently found altered in diabetic subjects; sometimes it is simply atrophied, sometimes slightly indurated, and, under the microscope, periglandular sclerotic lesions have been noticed. There are some rare cases in which the tissue of this organ is almost entirely destroyed in consequence of the presence of calculi.

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Results of an examination, macroscopical and microscopical, of the pancreas in 23 consecutive cases of diabetes mellitus. In 8 cases the pancreas was

found to present a normal appearance both macroscopically and microscopically; and in 4 more there was atrophy, but not more than could be accounted for by the general wasting. In 5 cases there was atrophy more or less marked, and out of proportion to the general wasting; and in one of these the atrophy of the gland was so extreme that the pancreas weighed less than one-fourth ounce. In 4 cases cirrhosis of the pancreas was present, and in 2 of these the changes were marked. In one case cancer of the pancreas was present, and in one the gland had undergone extensive fatty degeneration.

Results of the investigation of 54 cases of diabetes. In 40 of these the pancreas was found to be diseased, and in 36 the lesion was a simple atrophy. In 3 others fibrous induration was present, and in 1 case the pancreas was cystic. In 8 cases out of the 54 the pancreas was normal, and in 6 there was no record as to the state of the gland.

The atrophy of the pancreas in diabetes differs from the simple atrophy accompanying general wasting in the fact that in the diabetic pancreas the stroma of the gland is not only not wasted, but the pancreas shows signs of an interstitial inflammation, and the stroma occupies spaces left by the atrophy of the parenchyma of the gland. Hansemann (Med. Chronicle, May, '97).

In 70 per cent. of diabetic patients some alterations in the pancreas were found. Of special interest in this connection is a lipomatosis of the pancreas which may exist either in connection with the general excess of fat, or, on the other hand, may be found in lean subjects. Hansemann (Med. News, Jan. 22, '98).

Pancreatic diabetes is always grave. In view of data recently furnished by experimental pathology, there is no possible doubt as to the pathogenesis of the diabetes in this case: it is evidently due to the suppression of the secretions of the pancreas.

Diabetes never fails to appear after complete removal of the pancreas, if the animals live a sufficient time after the operation. This statement is founded on fifty-five experiments made on dogs. Minkowski (Berliner klin. Woch., 1092, No. 26, '92).

Coincidence of disease of pancreas and diabetes occurs more frequently than diabetes alone or pancreatic disease alone, and oftener than these two combined. Commonest disease of pancreas found in diabetes is an atrophy which differs from atrophy as the result of diabetes or of cachexias; comparable with certain forms of contracted kidney. Hansemann (Zeit. f. klin. Med., B. 26, '95).

Acute diabetes due to cancer of pancreas. Symptoms on admission simulated those of cirrhosis of liver. Dreschfeld (Med. Chronicle, Apr., '95).

Extirpation of pancreas of two dogs, leaving $^1/_9$ to $^1/_5$ of organ; animals became diabetic: one 4 and the other 13 months after. Sandmeyer (Zeit. f. Biol., B. 31, p. 12, '95).

Eels survived operation of removal of pancreas 7 to 12 days; 7 out of 11 showed no sugar in urine; 2 of them did. Former, perhaps, retained pancreatic remnants. Caparelli (Archives Italiennes de Biol., vol. xxi, p. 390, '95).

Extirpation of pancreas of 19 ducks and 5 carnivorous birds; 4 ducks showed slight glycosuria; 3 carnivorous birds manifestly glycosuric until death. Weintraub (Archiv f. experimentelle Path. u. Pharm., B. 34, p. 308, '95).

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The existence of pancreatic diabetes is established, but disease of the pancreas does not necessarily cause diabetes. Of 29 cases from the Massachusetts General Hospital that showed lesions of the pancreas, glycosuria was found in but 2, although in 12 cases there were no records of tests for sugar. Fatty stools are usually absent in cases of diabetes, and there is no record of their occurrence in 166 cases treated in the Massachusetts Hospital. R. H. Fitz (Yale Med. Jour., Mar., '98).

In the cases where the lesion of the pancreas is a minor one (slight indura-

tion, slight atrophy, etc.) it is not necessary to regard this slight lesion as the cause of the diabetes, for this disease is often accompanied by a generalized endarteritis,—a cause of sclerosis; or sometimes the diabetic cachexia engenders fatty degenerations. Contrary to the opinion held about half a century ago, experimental physiology has demonstrated that hepatic lesions are not a cause of true diabetes. They may, at most, cause an alimentary glycosuria.

The mild form of diabetes of the fleshy is purely of hepatic origin, the cells of the liver being only affected. In consequence of an anatomical or chemical change, as yet not known, they have lost their glycogenic power. Seegen (Zeit. f. klin. Med., vol. xiii, p. 267, '89).

Theory of Pavy—that in diabetes there is weakening of intestinal epithelium and of liver, which in the normal state prevents entrance into economy of too great quantity of sugar—does not explain most cases. Paton (Edinburgh Med. Jour., Dec., '94).

Extirpation of liver prevents ablation of pancreas to cause diabetes in the dog. Marcuse (Zeit. f. klin. Med., B. 26, p. 225, '94).

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A patient, aged 48 years, who, in 1887, suffered an attack of jaundice lasting six or eight weeks. The following year sugar was discovered in his urine, to the extent of $1\frac{1}{2}$ to 2 per cent. During an annually-repeated "Carlsbad cure" the sugar disappeared from his urine, but after 1892 it was continually present. In 1893 icterus reappeared, and there developed ascites, œdema of the legs, dyspnœa, and wasting. The liver and spleen were much enlarged. Ascitic fluid was withdrawn four times in all. After the last puncture the fluid did again collect. The amount of fluid ingested was at first greater than that eliminated, but eight weeks after the last puncture this relation was reversed. With the excessive excretion of urine the ascites and œdema disappeared. The patient increased in weight and gained strength, the jaundice disappeared, and the liver decreased in size. The patient remained for a long time in good health, then albumin appeared in the urine and œdema of the feet. During the persistence of the ascites the sugar disappeared from the urine, to return again as soon as the ascites was gone. After two and a half years of good health the patient died. The necropsy revealed cirrhosis of the liver with some contraction; tubercles in lung, pleura, and peritoneum; diabetic kidney, and atrophy of the pancreas. Pusinelli (Berliner klin. Woch., No. 33, '96).

Pathogenesis.—It would appear, from what has already been stated, that the causes of diabetes are multiple; it is evident that nervous diabetes differs from pancreatic diabetes. In obese diabetic subjects there is usually no appreciable lesion of the pancreas, and certainly no primary lesion. On the other hand, there are no nervous elements in these cases. This is, again, a different type of diabetes, and it would be easy to multiply the number. As for the immediate cause of diabetes, it is generally complex, consisting most frequently in an increased production of sugar and a diminution of glycolysis. In the light of our present knowledge it would be difficult to say much more upon this point if one wishes to refrain from mere hypotheses.

Complications.—I shall successively take up (1) those of the nervous system, (2) those of the vascular system, (3) those of the respiratory tract, (4) the digestive apparatus, (5) the *urinary* tract, and (6) the *skin* and the locomotor apparatus, ending with a summary statement concerning the diabetic coma.

Nervous System.—The most common secondary nervous lesions of diabetes are certain peripheral neuroses, especially

those which cause the abolition of the knee-jerk.

Eighty-nine out of 210 diabetics, or a little more than 43 per cent., presented either a total loss or a notable depression of the tendon-reflex. Nivière (Jour. de Méd. et de Chir. Prat., June, '89).

The condition of the knee-jerk tested in 184 cases of diabetes mellitus. As only 1 examination was made in 56 of the cases, they are excluded from consideration. Of the 128 remaining cases, the knee-jerk was normal in 113 and increased in 2. In the latter cases the patients were suffering from a severe form of diabetes. In 4 cases of severe diabetes the knee-jerk was absent or greatly diminished. The phenomenon was absent in 9 slight cases. Excluding 3 of these,—because 2 of the patients were tabetic and the third was too obese to admit of satisfactory examination,—there were only 10 patients (7.6 per cent.) in whom the knee-jerk was abolished or much reduced. Grube (Bull. de la Soc. Anat., Nov. 15, '93).

Analysis of 50 cases of diabetes with relation to the knee-jerks. They were both absent in 50 per cent., both present in 38 per cent., and feeble or one absent in 12 per cent. In patients under 25 years the knee-jerks were absent in 80 per cent.; under 30 years, absent in 75 per cent.; over 30 years, absent in 46 per cent. R. T. Williamson (Med. Chronicle, No. 2, '93).

The loss of the knee-jerk is due to a neuritis, which also underlies the neuralgias and various peripheral nervous phenomena. This neuritis is to be met with very much more frequently in the lower extremities than in the upper; it is generally bilateral, but may be one-sided. Auché (Lancet, Aug. 8, '91).

The other neurotic symptoms are pain and, more rarely, paralysis. It has been known for a long time that the neuralgia of diabetes is very painful and difficult to cure. Worms has noted that it is very often symmetrical, and states that the pain increases and decreases with the hyperglycæmia, which is certainly inconstant. Ziemssen was the first to refer this neuralgia to a neuritis. There are also shooting pains that somewhat resemble those of ataxia, and which may, in some cases, suggest the question as to whether there is not actual tabes: a very difficult problem to decide.

The relation existing between tabes and diabetes may vary in character; diabetes being present, certain symptoms of tabes may occur (*pseudotabes diabêtique*); or during the course of tabes sugar may appear in the urine (tabes with glycosuria). There is, besides, relation between true tabes and true diabetes, through the fact that these diseases occur in various persons of the same family, in consequence of an hereditary nervous taint, both appearing at times in the same subject. Blocq (Revue Neurol., Apr. 30, '94).

Vergely reported a case in which there were pains resembling those of angina pectoris.

The *paralyses* of diabetes present themselves as follows: 1. Limited and incomplete paralysis; this is, by far, the most prevalent form, as has been stated by Bernard and Féré in 1884. 2. Monoplegia. 3. Hemiplegia. 4. Paraplegia. The various forms of diabetic paralysis are sometimes associated, or are combined, with some unusual phenomena; for instance, facial hemiplegia preceded by facial neuralgia and a falling of the upper eyelid (Charcot, quoted by Bernard and Féré), or paresis of the extensors of the left thigh, impeded speech, and deviation of the mouth to the left (Charcot, *ibid.*), etc. The progress of these paralyses is also somewhat peculiar: they are sometimes migratory and transitory. Some of them are undoubtedly of central origin, but the majority are of peripheral origin, a neuritis forming their anatomical substratum. The peripheral variety is not exempt from this rule, as is proved by the existence, in diabetic paraplegia, of the symptom-

complex which Charcot has given the name of *steppage*, which is characterized by the lowering of the forward part of the foot in walking. This we know is due to the paralysis of the extensors of the foot, and it occurs in peripheral neuritis, but not in myelitis.

Cramps are another motor disturbance met with in diabetic subjects. These occur principally in the lower extremities, and at night they give rise to insomnia, which, according to Bernard and Féré, appears to be, in diabetic subjects, the first symptom of disturbance of the cerebral circulation, and may sometimes prove to be the forerunner of serious symptoms.

Frequency of cramps in the calves in diabetics. Disease frequently begins in form of an obstinate gastric catarrh; examination of urine for sugar in all patients suffering from rebellious catarrh of stomach, recurring in spite of all treatment desirable. Jacobson (Brooklyn Med. Jour., Nov., '94).

[Convulsions are rare. Some time ago I reported a case in which they, as well as aphasia and hemiplegia, depended upon microscopical cortical lesions. R. LÉPINE.]

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The complication of aphasia may occur in either pronounced or latent cases of diabetes, and may be associated with obstinate neuralgia, disturbance of vision, headache, or impairment of hearing. The aphasia may occur at any period in the course of the disease, and may last from a few hours to a month or more. The prognosis is always good. The condition can be said to resemble very closely the various forms of toxic aphasia that attend uræmia, pneumonia, gout, and tobacco-poisoning. Corneille (Gaz. Hebd. de Méd. et de Chir., Jan. 20, '98).

Perforating ulcer sometimes complicates diabetes. Folet and Auché have observed the falling off of the nails. In Folet's case they fell without giving rise to pain or inflammation.

Complications in the Organs of Special Sense.—Cataract is the most common symptom; it nearly always develops in both eyes; if not simultaneously, at least after a short interval. It is characteristic of this form of cataract to be relatively soft. Retinitis is next in order, with white exudations along the vessels and in the perimacular region.

Many causes may lead to ocular lesions in this disease. Among them are (1) diminution of water; (2) diminution of resistance of the vessels, due to general weakening of nutrition; (3) the existence of a toxic substance in the blood, produced by abnormal processes; (4) various complications. Mauthner (Inter. klin. Rund., No. 25, '93).

From a study of 25 cases in which lesions of various character were found in association with diabetes, three groups are distinguished: (1) a characteristic inflammation of the central region of the retina, with small, bright areas, and frequently, also, small hæmorrhages; (2) retinal hæmorrhages, with the consequent inflammatory and degenerative changes; (3) rarer varieties of retinitis and degeneration, the relation of which to the constitutional disease remains to be demonstrated. Hirschberg (Deut. med. Woch., Dec. 18, 25, '90).

This form is nearly always accompanied by slight hæmorrhages. True optic neuritis is much more rare.

The retinitis of diabetes distinguished from that of Bright's disease as follows: 1. The patches are irregularly distributed around the centre of the retina, not specially near the macula, and are met with on the nasal as well as on the temporal side of the disc. 2. The patches are never arranged in a fan shape. 3. They are never associated with papillitis or diffuse retinitis. 4. The hæmorrhages are, as a rule, punctiform, and not striated. 5. Hæmorrhages into the vitreous are common. Saundby (Birmingham Med. Rev., Jan., Feb., '93).

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Out of 140 diabetics, 34 were found who were the subjects of retrobulbar neuritis, which could not be attributed to abuse of alcohol or tobacco. Schmidt-Rimpler (Annal. d'Oculist., Sept., '96).

Unusual case of neuroretinitis where the changes were very characteristic of albuminuric retinitis, with two exceptions, namely: the star-shaped figure that is commonly seen at the macula in albuminuric retinitis was found below and to the nasal side of the disc, and the papilla was swelled more than is usually found in the albuminuric form. The round, white patches, the numerous small and flame-shaped hæmorrhages, and the œdema were found. Lens and vitreus were clear. Vision equaled $^{20}/_{70}$. The man complained only of decreasing vision.

The urine was repeatedly examined, but showed no trace of albumin or sugar, It was abnormally abundant, very rich in phosphates, and of normal specific gravity. At first he passed seventy-nine ounces daily. Hansell (Phila. Polyclinic, Jan. 30, '97).

This condition would explain the existence of the central scotoma sometimes met with in diabetes.

Case of diabetic neuritis with central scotoma. At autopsy zone of degeneration in optic nerve. Fraser and Bruce (Edinburgh Med. Jour., May, '95).

Besides the ocular lesions mentioned, Panas, and, after him, Hirschberg, have insisted upon visual disturbances caused by a defect of accommodation.

Out of 7176 eye-patients, 113, or $1\,^1/_2$ per cent., were diabetics. After ten years' existence this disease regularly causes alterations of the eye-structures, particularly of the lens and retina. In a third of the cases diabetes was found associated with some of the following significant changes: (1) uncomplicated paralysis of accommodation in middle life; (2) late myopia occurring between 40 and 60 years, without changes in the lens; (3) retinitis; and (4) quickly developed cataract in young persons in poor health. Hirschberg (Deut. med. Woch., Mar. 26, '91).

A diminution in the amplitude of accommodation seen in five diabetic subjects is dependent upon a general muscular weakness affecting more particularly the internal rectus muscles. Mauthner (La France Méd. et Paris Méd., Dec., '93).

Paralysis of the intrinsic muscles is very rare. Paresis of the abducens sometimes occurs; also a combined paralysis of the motor oculi, which gives rise to imperfect lateral motion of both eyes. A nuclear origin is evident in these cases.

Gellé states that suppuration of the ear is not rare in diabetics. The progress of acute otitis is the same as that observed in gout: rapid tumefaction, protrusion, and redness of the tympanum. During the second day severe pain, and afterward abundant suppuration.

Case of otitis media diabetica due to micro-organisms, diabetes having lowered vitality of tissues. Primary in tympanic cavity and secondarily a mastoiditis. In mastoid disease urine should always be examined for sugar. Davidsohn (Berliner klin. Woch., Dec. 17, '94).

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Inflammation of the mastoid is very frequent in diabetes mellitus. R. A. Urquhart (Med. News, Mar. 21, '96).

Two cases of acute mastoiditis in persons suffering from diabetes mellitus. In the first case, the patient, a female aged 50, induced the acute ear inflammation as the result of snuffing salt water up the nose. At first she made good progress under treatment. Soon, however, began to complain of considerable pain in the right half of the head, with continued discharge, renewed pulsating tinnitus and commencing mastoid tenderness, until it became requisite to open the mastoid process. The interior of the process was found made up of small cells, in many of which were unhealthy granulations.

In the second case, the patient, a man aged 58, had suffered from diabetes for about one year. The attack of middle-ear inflammation was induced as the result of influenza, and was soon complicated by mastoid involvement. When opened, extensive bone disease was found present. J. E. Sheppard (Med. News, May 2, '96).

Bouchardat dwells upon the diminution of the memory and the existence of a growing indifference; the loss of aptitude for any intellectual work, a tendency to anger, melancholy, and hypochondria. It appears to me that this author has laid the colors on rather heavily in painting his picture; mental symptoms are not usually met with in diabetic subjects independently of the many cases in which heredity plays an important part.

Sugar in the urine is not at all common among the insane. Forty cases observed who had diabetic relations, 10 of them having diabetic parents or grandparents, 14 having diabetic brothers or sisters, 12 having aunts or uncles, and 3 cousins suffering from this disease. Besides these there were 12 insane patients who had insane and diabetic relatives and 10 patients who were both insane and diabetic. Nearly all the cases of insane diabetics were affected with melancholia. The patients who had been diabetic and had then become insane had almost all lost some or all of the symptoms of the diabetes during the period of their insanity. Mallet (Bull. de la Soc. Anat., Nov., '90).

Diabetes is a disease which often shows itself in families in which insanity prevails; the two diseases are certainly found to run side by side, or alternately with one another, more often than can be accounted for by accidental coincidence or sequence. Maudsley ("Pathology of Mind," p. 113, '79).

The psychoses which develop in the course of diabetes usually take the form of melancholia. It is rarely that maniacal excitement is observed, circular insanity being oftener seen. Finder (Inaugural Dissertation, '92).

Three cases of diabetes seen complicated with mental disturbances. In the first case there was melancholic depression with suicidal ideas; in the second, mental debility; and in the third considerable pruritus vulvæ with general uneasiness. In all three cases there were no hereditary influences. S. Ierzykowski (Nowiny Lekarske, July, Aug., '93).

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Investigation carried on at the Banstead Asylum and extending over a period of eighteen months. Between the 11th of January, 1894, and the 25th of June, 1895, there were (excluding transfers) 268 males admitted to the asylum; and in 175 of these an examination of the urine was made within forty-eight hours after admission. In 12 instances, or in 6.85 per cent. of these 175 cases, sugar was almost certainly proved to be present. The following table indicates the varieties of mental disease under which these admissions labored, and the distribution among them of the 12 examples of glycosuria:—

Congenital Cases....	2	
Epileptic Insanity...	18	
General Paralysis...	30	3
Mania	43	
Melancholia	55	6
Delusional Insanity..	5	
Organic Dementia...	6	2
Senile Insanity.....	16	1
Totals	175	12

C. Hubert Bond (Jour. of Mental Science, Jan., '96).

However, when, as has been remarked by Bernard and Féré, an improvement in the mental condition occurs during the antidiabetic treatment, one would be inclined to admit a certain relation between mental symptoms and the diabetic dyscrasia. The same conclusion is reached when the glycosuria and maniacal symptoms alternate. Cases of this kind have been reported.

Vascular System.—The lesions of the

heart have been indifferently studied until of late. Among 380 diabetics Mayer has observed cardiac complications in 82.

Of 380 cases, 337 were in the first stage of diabetes and 47 in the second stage; of the latter 26 were under observation during both stages. Increased cardiac volume, either from hypertrophy or dilatation, is much more frequent in diabetes than one would suppose from the literature, it being found without other anatomical lesions in 82 of the 380 cases. J. Mayer (Zeit. f. klin. Med., B. 14, H. 3, '88).

These patients are either of very delicate constitutions, with the heart weak and irregular, or they are obese diabetics, with the face red or cyanosed, who present a strong cardiac impulse, and signs of dilatation of the heart, either with or without atrophy. These patients are liable to die suddenly. Such cases should not be confounded with the true diabetic coma; moreover, they differ from the latter by the absence of acetonuria and by the suddenness of death. Very often it is after a voyage or fatigue of some kind that these patients fall into a state of collapse, with cold extremities; small, feeble pulse; a loss of consciousness, more or less rapid; and death in a few hours.

Five cases of diabetic angina pectoris; in one sudden death during attack. Vergely (Jour. de Méd. de Bordeaux, '94).

There are also mixed cases, where, with a weak heart, there is, at the same time, autointoxication. I have myself observed three such cases. The anatomical examination of the heart shows the myocardium rather atrophied and pale.

In Virchow's necropsy the heart was enlarged in nine cases out of sixty-nine, and exclusive of those in which there was enlargement from anatomical causes (vascular, valvular, or renal disease), a percentage of 13. Mayer (Zeit. f. klin. Med., B. 14, H. 3, '88).

Of the patients who died of diabetes at the Berlin Charité 10 per cent. had cardiac enlargements without valvular or arterial lesions or renal disease. O. Israel (Annual, '89).

Arteriosclerosis is exceedingly common in diabetics. Ferraro dwells particularly upon generalized endarteritis. According to him, the atrophic and necrotic lesions reported in various organs are due to this endarteritis.

Œdema, which is quite common in diabetes, is not always symptomatic of an affection of the heart. It may possibly be due to a complication of Bright's disease of the kidneys, but this is extremely rare; to a venous thrombosis, of which examples have been reported by Pavy, Gull, Dionis des Carrières, Leudet, Potain, and others. Sometimes there appear to be active tumefaction and other inflammatory phenomena that are apparently due to vasomotor disturbances. In many cases the œdema depends upon the impaired nutrition of the vessels caused by the dyscrasia.

Pulmonary Apparatus. — The most frequent complication in this direction is pulmonary phthisis. At least one-third of the cases of diabetes treated in the hospitals are on account of this. The lesions of diabetic phthisis are almost always those of bacillary tuberculosis. The exceptions met with are cavities following pulmonary gangrene, which, as has been remarked by some clinicians, have not the usual fœtidness. There are also ulcerations due to a fibrous ulcerative pneumonia (Marchand). Dreschfeld, Fink, and others have reported similar cases. After phthisis, pneumonia is a serious complication of diabetes.

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Pneumonia is rare in diabetes. In 700 cases of diabetes only 7 cases of

pneumonia observed, not counting 1 case of broncho-pneumonia and 5 of influenza-pneumonia. In none of these cases did the sugar disappear during the febrile period. The prognosis is always unfavorable. Bussenius (Berliner klin. Woch., No. 14, '96).

It may begin like ordinary pneumonia. I have seen several such cases. The temperature does not differ from that usual in pneumonia, and the urine remains, notwithstanding the fever, at its usual ratio. There are also cases of rapid pneumonia, of which I have observed several. In the primary congestive period death may ensue in a few hours. Pneumonia is principally met with in diabetics presenting intense glycosuria.

Digestive Apparatus.—The gums are usually red and tumefied. Dental alveolo-periostitis exists, as a rule, when the diabetes dates back several years. The teeth soon become loose in the alveoli and fall out, and dental caries frequently exists. In arthritic diabetes pharyngitis is often present, or, at all events, congestion of the pharynx, with the expectoration of sanguineous mucus.

Form of pharyngitis symptomatic of diabetes or albuminuria observed. There is at first a slight difficulty in deglutition, a sensation of pressure in the throat, and a deposit of mucus which annoys the patient considerably. An examination of the throat shows the pillar of the fauces and the posterior portion of the pharynx to be reddened, the mucous membrane red, swelled, and frequently covered by a layer of glairy mucus. Garel (Universal Med. Journal, Dec., '94).

Laryngeal vertigo may also occur, but this symptom belongs rather to the arthritis than to the diabetes.

The stomach is dilated in all cases of polyphagic diabetes. In the latter cases the digestion is *apparently* accomplished much more readily than one would suppose, in view of the enormous quantity of food taken, but this is often only apparently the case, as, notwithstanding the absence of symptoms of indigestion, the food is badly digested. The hydrochloric acid is often absent in the gastric juice (Rotenstein, Gans, Hönigmann). Sometimes there are lesions of the mucous tract (interstitial gastritis, atrophy of the glands); in other cases no distinct lesions have been found. Gans and Hönigmann claim to have found hyperacidity in certain cases.

The disturbances of the intestinal digestion are less known, because they are less accessible for investigation.

Among 140 diabetic patients Seegen found the liver enlarged in 28: about 20 per cent. Others have found a greater proportion of enlarged livers.

In 60 per cent. of diabetics there is a manifest change in the liver, usually in the right lobe. The density of the organ is increased in one-third and its sensitiveness in one-fourth of the cases. It is usually increased in size, this increase consisting of elements of induration. Glénard (La Semaine Méd., Aug. 3, '90).

In diabetics the function of the liver is unimpaired; cirrhosis and other intercurrent affections diminish or abolish glycosuria. Dujardin-Beaumetz (Bull. Gén. de Thér., Nov. 15, '91).

In case of diabetes due to influenza liver weighed seven pounds; hypertrophic cirrhosis with pigmentation throughout hepatic cells, portal spaces, and biliary ducts and vessels. Pancreas large and striated; glands dissociated by fibrous tissue; cells infiltrated with pigment. De Massary (Bull. de la Soc. Anat., July 10, '95).

I have for a long time insisted upon the fact that during life the liver, being gorged with blood, presents a greater volume and consistency than in the cadaver. The differences concerning the condition of the liver in diabetes are,

in a measure, due to this fact. In certain subjects attacked with severe diabetes, a brownish color of the skin, and especially that of the face, similar to that witnessed in Addison's disease.

> Case of *diabète bronzé*, of which only 9 certain cases, all by French observers, and 2 doubtful ones have been published. Marie (La Semaine Méd., May 22, '95).

The liver is then atrophied and hard, and there may be ascites. Hanot and Chauffard published two cases of this kind in 1882. Cases were afterward reported by Letulle, Hanot and Schachmann, Brault and Galhard, Barth, and others. Upon section, the liver is found hard and distinctly and uniformly sclerotic, and a microscopical examination shows the hepatic cells to be infiltrated with yellowish-brown or black granulations, while at certain points there are large black masses. The sclerotic connective tissue shows by its topographical distribution the existence of bivenous cirrhosis. In the portal spaces obliterative endarteritis is found, with net-works of biliary pseudocanaliculi, masses of pigments, and vestiges of destroyed hepatic cells.

The liver is the seat of predilection for deposits of pigment, but it has also been found in the pancreas (Hanot and Chauffard); also in slight quantities in the kidney, and even in the heart. Finally, as I have already mentioned above, it occurs in the skin itself.

The quantity of iron chemically determined in the pigmented organs is variable: Quincke found in a case an enormous quantity of dry matter. The liver was said to contain, in all, 27 grammes. Zaleski justly remarks that this pigmentation is not characteristic of iron.

Urinary System.—Urinary complications are very common. First there are those due to previous morbid conditions (gout, for instance), and, in particular, there are those which depend upon the diabetic dyscrasia, and which, as is known, are *complex* in the case of gravel diabetes.

The renal lesion most common in diabetes has been reported by Armanni and fully described by Strauss.

It affects exclusively the zona limitans, where it invades the straight tubules of Henle, which may be either large or slender; sometimes, likewise, some of the collecting tubes (Strauss). As to the localization, there are individual varieties; in one instance it was found exclusively in the ascending branch of the loop.

Armanni regarded this lesion as a hyaline metamorphosis. Ehrlich, with the aid of iodized gum, proved that it is really an infiltration of the cells by the glycogenic substance. He regarded it as a constant symptom in diabetes; but this opinion appears to be somewhat exaggerated. At all events, this lesion proves the facility with which the organism synthetically transforms the sugar into glycogen. Ehrlich thought that the sugar so transformed was that contained in the urine. Strauss—basing his opinion upon the fact that the lesion is localized in the zona limitans in the neighborhood of the capillaries interposed between the uriniferous tubules—is inclined to believe that this sugar comes from the blood of these capillaries.

> [In support of this hypothesis the fact may be advanced that the glycogenic infiltration may take place in other organs besides the kidneys; the brain, for instance (Futterer). Very recently Strauss observed that the glycogenic reaction is sometimes absent, and that there is only a hyaline substance. R. LÉPINE.]

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A method for detecting and fixing sugar in the organs just at the place of its excretion. Observations made on the kidneys of rabbits, diabetes having been produced experimentally. The kidney is removed rapidly, and a small portion is placed for fifteen to twenty minutes in a watery solution of phenylhydrazin and glacial acetic acid, previously warmed in a water-bath. It is then washed in water acidified with weak acetic acid, hardened in 10-per-cent. formol solution, frozen, and sections cut. The sections showed the characteristic yellow needles, indicating the presence of sugar, chiefly in the interstitial spaces between the uriniferous tubules. The crystals were much more scanty in the capsules of the glomeruli, while in the lumina of the uriniferous tubules they were almost absent. The chief masses of crystals were certainly situated in the interstitial vascular and lymph-spaces. Seelig (Archiv f. experiment. Path. u. Pharm., B. 37, H. 2, 3).

In certain cases of severe diabetes, particularly when death has been caused by coma, Ebstein has seen a peculiar alteration in the epithelium of the convoluted tubules in which circumscribed areas alternate with normal portions. According to Albertoni, this lesion is due to the acetone or to the acids which exist in the blood in severe diabetes.

Quite recently, and only in cases in which death occurred during coma, Fichtner has reported a very circumscribed alteration in the cells of the convoluted tubules, which consists of an infiltration of fat at the base of these cells, which is detected by osmic acid. I have also met with this alteration, to which the attention of pathologists should be directed.

In cases of diabetes 644 post-mortem examinations performed. The condition of the kidneys was carefully noted in 241 of these cases. In the remainder they were reported healthy, or only the gross appearances were noted. Of the 241 cases, 68 are reported as hypertrophic; 52 as hyperæmic; 94 as the seat of a nephritis; 17 as having fatty degeneration; 7 had epithelial accumulation; 2 had cysts; and 1 multiple abscess. Colcord (Kansas Med. Jour., Apr., '91).

Lesions similar to those in Bright's disease rarely occur in the diabetic kidney.

Several authors have dwelt upon the frequency of cystitis in diabetic subjects.

A complication which is much more rare is *pneumaturia*, in which the patient toward the end of micturition ejects a jet of gas through the urethra. In a patient observed by Mueller, the gas, which was collected under water, was composed as follows: H, from 44 to 57 per cent.; N, from 33 to 35; CO_2, from 9 to 19; O, traces; CH_4, traces. Freshly-voided urine contained 1 per cent. of sugar, but sometimes there was no trace of it. There is no doubt that the phenomenon of the fermentation of the sugar is due to the presence of micro-organisms in the bladder.

Skin.—The cutaneous complications occurring in diabetes are pruritus, eczema, and gangrenous lesions. The pruritus may exist without any appreciable lesions. It affects the genital organs, especially the glans penis in men. In women it is much more painful, affecting the vulva. It gives rise to an itching, burning sensation, with exacerbations, which may cause insomnia and various nervous symptoms. Sometimes it occurs early and forms one of the symptoms revealing the existence of the disease. Diabetic eczema is of two varieties: either genital, in which case, like the pruritus, it appears to be due to the local irritation caused by the sugar, or general, when it occurs principally in arthritic subjects.

Chronic eczema, located in the genital organs in women, may be pachydermic. (Fournier.)

The gangrenous dermatoses have been carefully studied by Marchal, of Calvi, and more recently by Kaposi.

Furuncle and anthrax frequently complicate diabetes. Anthrax presents a somewhat peculiar type: beginning insidiously, and with but little pain; the œdema is slight and the febrile reaction is either slight or does not exist. Very frequently the affection is complicated with a phlegmon or with gangrene.

> Diabetic gangrene is not nearly so rare as most surgeons suppose. Fourteen cases observed. T. G. Morton (Philadelphia Med. Times, Jan. 1, '89).
>
> While diabetic gangrene is generally due to the common cause of senile gangrene, — namely, arteriosclerosis, — there is, in diabetes, an increased susceptibility to wound-infection. As long as only one or two toes are affected, it is safe to wait for the line of demarkation. Extension of the gangrene to the sole or back of the foot indicates amputation. Heidenhain (Deut. med. Woch., Nos. 36, 37, '91).

The gangrene may be primary in diabetics, without any previous phlegmon or anthrax. In this case it is dry or mummified, like senile gangrene. It begins most frequently in the toes, and has been seen to originate simply in a local asphyxia. I have already mentioned the diabetic perforating ulcer (see NERVOUS COMPLICATIONS).

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> Diabetic gangrene is not infrequently the first symptom to attract attention to diabetes in an apparently-healthy person. Hence the necessity of examining the urine in cases of gangrene. Roser (Berliner klin. Woch., June 22, '96).
>
> If a gangrenous inflammation occur in comparatively-young persons, the urine should be examined, as diabetics may thus suffer from gangrenous inflammations. Diabetic gangrene often arises in the presence of arteriosclerosis; in 9 out of 11 cases observed severe arteriosclerotic changes were present in the small vessels. Koenig (Berliner klin. Woch., June 22, '96).

A form of lichen resembling exanthema has been described in diabetes. In a patient seen by Robinson touching the tumor caused a burning sensation.

> Nine cases observed where psoriasis co-existed with gout or diabetes, or both; a causal relation between those affections does undoubtedly exist. Karl Grube (Berliner klin. Woch., vol. xxxiv, No. 52, p. 1134).

Locomotor Apparatus.—The cartilages may present the lesions upon which Krawkow dwells, which are due to a deposit of glycogen.

Frerichs refers to the lightness of the bones. They have been found to be extremely light in some cases. I have stated above that in serious cases the lime in the urine is relatively increased. Perhaps these anomalies bear less relation to the hyperglycæmia than to the acid dyscrasia of the severe form of diabetes, to which we shall now refer.

Diabetic Coma. — Under this head have been grouped those cases in which the patient falls, in a very short time, into a comatose state, which is nearly always mortal.

Stosch, in 1828, appears to have been the first to mention this dangerous complication of diabetes. Twenty years later Pront related 4 cases of diabetes which terminated suddenly in death. Grisolle, Bence-Jones, Petters, Balthazer, Foster, Kaulich, Howship Dickinson, and others have reported similar cases, but the first extensive article on the subject is that of Kussmaul.

Frerichs separates these cases into three categories. We have already studied the first (rapid death by cardiac paresis, see

above). In one of the remaining two the first appearance is not very sudden, there being premonitory signs: increased weakness, gastric disturbances, anorexia; the breath and urine nearly always give off the penetrating odor of acetone, and the urine, after the addition of perchloride of iron, usually presents a red color.

Very frequently, as I have already mentioned under SYMPTOMS, there is a decided difference between the quantity of sugar revealed by Fehling's solution and the smaller quantity registered by the polarimeter. According to my observations, the pulse is always accelerated, then cephalalgia sets in, and a peculiar dyspnœa, which is not explained by auscultation of the lungs, and which is characterized by a great frequency and depth of the respiratory movements. Occasionally there is cyanosis, with lowering of the temperature, then somnolence, ending in coma and death. The total duration of the symptoms in this variety is from three to five days.

In the third category of such cases the dyspnœa does not exist: the patient becomes more or less suddenly excited as though intoxicated, vertigo, delirium, somnolence, and coma. In this variety, which is rather more rare than the preceding, the urine presents the same characteristics.

It is generally admitted that the pathogenic element of diabetic coma is an intoxication, but it has not yet been established with certainty to what substance this is due.

Petters—to whom, in 1857, the discovery of acetone in the urine of one of his patients is due—does not hesitate to attribute these accidents to the presence of this substance. This opinion was all the more readily accepted during a certain time, through the fact that the urine in the majority of severe cases of diabetes contains a considerable quantity of acetone (up to 3 grammes per day —Engel). Experiments, however, have not coincided with this interpretation, for animals support much larger doses without presenting the symptom of diabetic coma.

Gerhardt, who in 1865 discovered the fact that the addition of perchloride of iron to the urine of certain diabetes produced a red color, thought that it was due to the diacetic ether which decomposes readily in acetone, CO_2, and alcohol. Von Jaksch attributes this coloration to the diacetic acid; but the fact that the injection of considerable doses of this substance does not give rise to symptoms resembling those of diabetic coma leads one to doubt that the accidents of diabetic coma are solely due to its presence.

Boussingault formerly found as much as 1.6 grammes of ammonia per litre of diabetic urine; this enormous daily excretion of ammonia appeared incredible, and Koppe argued against the exactitude of Boussingault's method; but in 1880, Hallerworder fully confirmed the results of Boussingault, basing his observations upon the researches of Walter, made according to the directions of Schmiedeberg.

> [These researches proved the fact that where a mineral acid penetrates into the blood ammonia is formed in the economy, by neutralization. R. LÉPINE.]

Hallerworder did not hesitate to affirm that in diabetic subjects there exists an excess of acid, perhaps lactic acid. Stadelmann, by treating all the acids and all the bases in the urine as had been done by Goethgens, found that, while in the normal urine the known acids exceed the bases, the contrary is the case in diabetic urine, and that consequently there must exist in the latter some unknown

acid. As a matter of fact, from several litres of diabetic urine Stadelmann succeeded in directly extracting crotonic acid, and Minkowski, continuing his researches, proved that the crotonic acid does not pre-exist in the urine, but that it is a product of the decomposition of oxybutyric acid. At the same time Külz, in view of the fact that the urine of some diabetics deviates strongly to the left after the fermentation of the sugar, discovered, on his side, that this deviation is due to a substance of a composition identical with that of the known oxybutyric acids, but differing from the latter through the property of deviating to the left. Deichmüller, Zymanski and Tollens, Lépine and Hugounenq, and others have confirmed the existence of oxybutyric acid in the urine of certain diabetics.

In twenty-one cases of diabetic coma all patients eliminated large quantities of acid; but a comatose condition may be due to increased destruction of nitrogenous material in other maladies, and administration of alkalies is without effect; hence, coma is not due to acid intoxication. As means of restricting nitrogenous destruction, 8 ounces of fat daily; milk or levulose if disgust occur. Klemperer (Münch. med. Woch., May 14, '95).

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The most probable cause of diabetic coma is the formation and retention in the organism of the decomposition-products of sugar, such as acetone, diacetic acid, and more especially of beta-oxybutyric acid. These acids have frequently been found both in the blood and in the urine of patients suffering from diabetic coma. Among the predisposing causes of coma, age ranks as an important one, this complication of diabetes being especially frequent between 20 and 40 years of age. Among other causes, Cassoute notes an exclusively-meat diet and many agents, such as opium, which tend to restrain and diminish the glycosuria. Cassoute (Gaz. des Hôp., '96).

According to our present knowledge, it may be definitely stated that diabetic coma is due to an acid intoxication produced by the circulation of excessive quantities of beta-oxybutyric, and possibly also diacetic, acid in the blood, these being the products of the decomposition of the body-albumins. Thomas B. Futcher (N. Y. Med. Jour., vol. lxvi, No. 25, p. 821, '97).

It is generally admitted that acetone arises from the decomposition of oxybutyric acid, according to the following equations:—

$$\underset{\text{oxybutyric acid}}{C_4H_8O_3} + O = \underset{\text{diacetic acid}}{C_4H_6O_3} + H_2O$$

$$C_4H_6O_3 = \underset{\text{acetone}}{C_3H_6O} + CO_2$$

Von Jaksch has supposed that the acetone, instead of originating from the diacetic acid, might, on the contrary, give rise to it, by combining with the formic acid.

$$\underset{\text{formic acid}}{CH_2O_2} + C_3H_6O + O = C_4H_6O_3 + H_2O$$

The quantity of oxybutyric acid eliminated per day is not insignificant, for 4 grammes of ammonia neutralize about 30 grammes of oxybutyric acid, and some diabetics excrete more than 4 grammes of ammonia daily.

There can hardly be a certain parallelism between the excretion of ammonia and that of the oxybutyric acid.

The ammonia may either be saturated with other less known acids or its formation may be due to other factors.

It must, moreover, not be forgotten that oxybutyric acid is not peculiar to diabetic coma. Minkowski has eliminated 3 grammes from a non-diabetic woman, attacked by pseudoscorbutus in a case of lateral amyotrophic sclerosis.

To sum up, there seems to be no doubt

that in a certain number of cases of severe diabetes the blood is less alkaline. Is this lesion the cause or the effect of the symptoms? I am inclined to believe, with the majority of authors, that it is in part the cause, and I am surprised at the opposite interpretation given by Klemperer, who says that the blood is acid because there is coma. Clinical observations seem to me to contradict this view, for the lack of alkalinity of the blood precedes the beginning of the coma. Finally, the cases in which purely-alkaline treatment, according to Stadelmann's method, has been manifestly useful would seem to favor the opinion which I defend. I have myself seen several such cases.

It is likewise an incontestable fact that the acid intoxication is merely an element of the diabetic coma. It is certain that the kidney is not healthy when the symptoms present themselves (see above the lesions of Ebstein and of Fichtner). Finally I may mention lipæmia, to which English physicians attach a pathogenic value.

Acute Form.—Diabetes, in the great majority of cases, is an affection progressing in a chronic condition, but in some cases the onset is sudden and the progress of the disease acute.

Out of 77 cases of children traced to their termination, 14 recovered, 7 improved, 4 remained unimproved, and 52 died. C. Stern (Archiv f. Kinderh., B. 11, H. 2, '89).

Gravity of prognosis of diabetes in children. Of 108 cases, 64 per cent. terminated fatally. Prognosis graver in proportion as children are younger. Wegeli (Archiv f. Kinderh., B. 19, H. 1, 2, '95).

In adults proportion of grave cases does not exceed 5 per 1000. Worms (Bull. de l'Acad. de Méd de Paris, July 23, '95).

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The rate of mortality from diabetes has risen, in Paris, within the last ten years, from an average of 8 in each 100,000 population to an average of 13; while in Copenhagen it has risen from 5 to 8; and in England and Wales it has increased, in fourteen years, 70 per cent., after allowing for the increased population. Saundby (Editorial, Modern Med. and Bact. Rev., Apr., '97).

Authentic cases of this nature are rare, because the evolution of the disease may actually have been an incipient one, and have remained unnoticed up to a certain period, when there is a sudden aggravation.

[Loeb reports the case of a chemist who, while in good health, examined his own urine and found it normal. Soon after he became ill, and experienced violent thirst. At this time the urine contained 8 per cent. of sugar. Death took place in five weeks. R. LÉPINE.]

Death is not invariably the termination of acute diabetes. Several cases of recovery have been reported. Holsti saw, in a man 41 years old, diabetes having a very sudden beginning, to judge by the thirst, and which was only subjected to the dietetic treatment six weeks later. After three days abstinence from amylaceous food the urine, which had contained 8.8 per cent. of sugar, ceased to contain any, and the future use of amylaceous food did not cause a return of the diabetes. This is assuredly a rare case. More frequently a diabetes having an acute beginning passes to a chronic condition.

A mild form of diabetes has sometimes been described as *intermittent*; it is due in a measure to the influence exerted by a too liberal alimentation. As soon as a proper diet is followed the glycosuria does not exist.

This is not, properly speaking, an intermittent diabetes. Such cases belong

rather to the type of alimentary glycosuria.

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Study of six cases of recurrent transitory diabetes. The proportion of sugar was very variable, but usually 30 to 40 g. a day. The glycosuria diminished rapidly under a rigid diet. The amount of sugar was invariably less in the second and third attacks than in the first, but the attacks lasted longer with each relapse, 1 or 2 g. of sugar persisting for weeks or months. As a rule, there was albuminuria, which subsided with the glycosuria. The proportion of uric acid was high. In all cases there was a moderate degree of polyuria. Thirst and hunger were never marked, but emaciation, sense of physical exhaustion, and depression were prominent symptoms; these recurred with diminished intensity with each attack. Months or years of perfect health sometimes intervened with the attacks. In one case ordinary diabetes supervened. The recurrent transitory variety of diabetes is connected in certain cases with a constitutional arthritism, in others with an acquired arthritic tendency. Transitory diabetes is not dangerous in itself; it is the expression of an enfeebled constitution or a passing dyscrasia. Dreyfus Brissac (Sem. Méd., Feb. 12, '97).

True intermittent diabetes is almost independent of the alimentation. It has been reported by Bence-Jones, Baudremont, and others. Saundby reports one case. I have myself seen one alternate with albuminuria. This form of diabetes is principally met with in arthritic and hysterical subjects. Its appearance depends principally upon nervous causes, moral or otherwise.

Duration.—There is so little resemblance between the various cases that an average duration, even supposing that it could be rigorously established, would be of no importance. It suffices to say that in a general way the average duration of diabetes is several years.

I am consequently much surprised at the results given by Griesinger concerning 100 cases. In 13 the disease only lasted from 6 months to 1 year; in 39, 1 to 2 years; and in 20, 2 to 3 years, which would make the duration of the disease in *three-fourths of the cases* from 6 months to 3 years.

The duration in children varies greatly. Out of 34 cases the shortest duration was two days; the longest had not terminated at the end of five years. In 7 cases it did not last one month, and of these 1 was cured. Seventeen lasted less than a year, and of these 7 were cured. Ten lasted over a year, and not one of these recovered, and it may be said that recovery scarcely occurs where the duration is more than one year. C. Stern (Archiv f. Kinderh., B. 11, H. 2, '89).

In order to explain such remarkable figures it must be supposed that the diabetes was latent, in the beginning, in a large number of the patients, and that these statistics include a great many serious cases.

Termination.—It is evident that diabetes, which is but seldom cured, generally ends in death. In explanation of this rather naive statement, which might lead to a false interpretation, it must be borne in mind that the duration of the disease is a long one, and that in a great number of cases mild diabetes allows the patient to live to an advanced age.

In referring to the complications of the disease, I have already mentioned the frequency of phthisis, and the even greater prevalence of coma, in diabetics enjoying a certain affluence. To these should be added gangrene, pneumonia, and the numerous complications which may affect the organism when already debilitated by diabetes.

In a certain number of cases, particularly in arthritic subjects, the diabetes may be changed into another malady. Following traumatisms, it may end (after

a certain duration of the glycosuria) in simple polyuria.

Prognosis.—It may be inferred from the preceding statements that it is difficult to speak of the prognosis of diabetes in general; this can only be established in each individual case.

It may be said, however, that arthritic diabetes and many cases of nervous diabetes are usually not very severe.

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In the nervous variety the glycosuria is often quite moderate, and may even disappear, leaving behind a simple polyuria. The type developed under the influence of gout in arthritic subjects is associated with an intermittent, but abundant, glycosuria, and is comparatively benign. Certain diseases of the pancreas, such as calculi of Wirsung's canal, and sclerosis of the whole parenchyma, may be followed by a rapid and dangerous diabetes. There are other varieties difficult to classify. Lépine (Sem. Méd., Aug. 27, '97).

The progress of a not essentially grave case varies considerably according to the treatment to which it is subjected. It will be much more benign if the patient is intelligent and docile, for there are few chronic diseases in which proper care and attention are as beneficial as in diabetes.

Treatment.—In my opinion, the treatment of diabetes should not be a systematic one. The first thing to be done, and this is a precept to be applied in the treatment of any disease, is to make a careful study of the patient—to individualize him, as it were—to watch attentively the effects of the treatment, and to have no hesitation in modifying the same, according to the results. The diet is more important than the medicinal treatment. As in all diabetics the power of assimulating sugar is more or less diminished, it is important to limit the ingestion of hydrocarbon food. The rule is to forbid it as far as possible, and to advise a diet of meat, fish, eggs, green vegetables, particularly those which contain but little starch, also salad, cheese, nuts, etc.

Too great a quantity of meat should be avoided.

In the treatment of albuminuria in diabetes it is important to bear in mind that the maintenance of the patient's strength is of more importance than the loss of more or less albumin or sugar. In the slight form of albuminuria the general condition is good and the case must be treated as an ordinary case of diabetes. The strong alcoholic drinks must be prohibited and only the light wines or beer allowed. In the grave forms of albuminuria symptoms of Bright's disease are present and the kidneys are affected. But the milk diet so frequently employed in Bright's disease ought not to be prescribed, as the glycosuria and polyuria would thereby be increased. A mixed diet is to be recommended. Jacobson (Gaz. des Hôp., Aug. 24, '95).

Case in which suppression of carbohydrates from food and one day of absolute fast caused sugar to permanently disappear from urine. Weintraub (Archiv f. exper. Path. und Pharm., B. 34, p. 169, '94).

The kernel of the pea-nut as food for diabetic patients. Contains 14 per cent. carbohydrates, 29 per cent. proteids, 49 per cent. of fat. Stern (Med. News, June 8, '95).

In healthy persons submitted to diet from which carbohydrates are absolutely excluded, quantity of acetone increases progressively for seven or eight days, then becomes stationary at from $^1/_3$ to $^1/_2$ grain. Diabetes complicated by acetonuria is rather rapid in its evolution and terminates in death from twelve to twenty months in cases in which there is no gangrene. Treatment: hyperalimentation (carbohydrates in small quantities, albuminoids in not too great abundance, fat, and alcohol); rest.

Hirschfeld (Zeit. f. klin. Med., B. 28, H. 1, 2, '95).

Literature of '96-'97-'98.

The general principles of the treatment of albuminuria in diabetes mellitus are:—

1. To diminish the quantity of nitrogenous foods.

2. To increase the proportion of green vegetables.

3. To moderate physical exercise.

In mild cases of albuminuria one first pays attention to the diabetes. A. Robin (Bull. Gén. de Thér., Aug. 15, '97).

Some patients will not thrive on any diabetic treatment. Old people often emaciate if carbohydrates are dropped. In the diabetes of young people carbohydrates must be withheld as much as possible. Under a proteid diet young patients live longer. Patients generally improve on milk. Jacobi (Bost. Med. and Surg. Jour., Sept. 9, '97).

The exclusion of carbohydrates can never be complete and many patients do better on a diet not too rigid. The patient should be put on a rigid proteid diet to see what can be accomplished. Then one article after another containing more or less starch or sugar may be added, watching the urine, and finally the diet may be made as liberal as the individual case will permit. Tyson (Boston Med. and Surg. Jour., Sept. 9, '97).

It is of great importance to prescribe definite quantities, and to test the effect of the diet by weekly body-weighing, urine-measurement, and sugar-estimation. Carbohydrates should be excluded as rigidly as possible without damage to the nutrition and general condition of the patient, the case being very carefully watched. Robert Saundby (Boston Med. and Surg. Jour., Sept. 9, '97).

A diabetic should be placed under no different conditions of diet than are granted to the healthy person. Conclusions:—

1. Sugar is always present in the blood.

2. The absence of carbohydrates from the diet does not cause a disappearance of the blood-sugar.

3. The systemic and ingested albumin is capable of furnishing sugar by its decomposition.

4. An increased decomposition of albumin due to the enforcement of a purely-nitrogenous diet means an increased metabolism and consequent loss of body-weight.

5. The administration of carbohydrates retards metabolism.

6. The diabetic has an especial predisposition toward increased metabolism.

7. The diabetic has not lost the power of oxidizing sugar.

8. The abnormal metabolism of albumin results in the production of toxic bodies.

9. The depressed nervous condition of the diabetic is especially favorable for the action of these bodies.

10. The production of toxic bodies is prevented or retarded by the administration of carbohydrates.

The diabetic should live upon a diet which keeps his body-metabolism at its lowest, and for this carbohydrates are necessary. There is no cure for the condition; the treatment must simply be directed to prolong life, and this a rigid proteid diet is not capable of doing. Munson (Jour. Amer. Med. Assoc., May 15, '97).

If the diabetes be pancreatic, neither diet nor anything else will do much good. In nervous diabetes the diet should be restricted, persevering as long as nutrition does not weaken and the patient can digest the diabetic diet. Ebenezer Duncan (Boston Med. and Surg. Jour., Sept. 9, '97).

An absolute diet without vegetables should not be given, as in bad cases it leads surely to more rapid accumulation of acids in the blood, and diabetic coma is an acid intoxication. Even in the lightest cases, however, for two or three weeks three or four times a year absolutely no carbohydrates should be taken, as thus the metabolic faculty for sugar which has been injured is given that strictly-physiological rest so conducive to its recuperation. Lee (Med. Rec., May 7, '98).

The abuse of the albuminoids by diabetic patients may cause not only the usual disturbances, but it may also increase the sugar in the urine, as Naunyn has justly remarked. It has also been noticed that an exclusively-meat diet may bring about some particular dyscrasia, ending in diabetic coma. This exclusive diet, which was formerly lauded by Cantani, is consequently not to be recommended. It is very difficult to absolutely deprive the patient of bread, so a small quantity, as small as possible, may be allowed, or, in place of this, an equally-small portion of potatoes.

Diabetic biscuit consisting of combination of aleuronat and cocoa-nut powder. Williamson (Brit. Med. Jour., Apr. 27, '95).

Effect often seen with ordinary carbohydrates—of increasing output of sugar beyond the extra quantity given—not observed with levulose in eight cases. White (Guy's Hosp. Reports, vol. iv, p. 133, '94).

Case of chronic diabetes can utilize $1\frac{1}{2}$ ounces or more of levulose daily. Haycraft (Med. Chronicle, Sept., '94).

Increased excretion of glucose after administration of levulose. Bohland (Ther. Monat., p. 377, '94).

Levulose can be given in moderate quantities in slight forms of diabetes, without injurious results as regards sugar excretion, urine, etc. Utilized in the system, though dextrose and cane-sugar excreted. Grube (Zeit. f. klin. Med., B. 26, H. 3, 4, '95).

[Levulose may generally be given in small doses to patients suffering from mild diabetes; but, if small daily dose be exceeded, excretion of sugar increased without benefit to patient. R. LÉPINE, Assoc. Ed., Annual, '96.]

Milk is not so injurious as is supposed. It is far from certain that lactose generates glycosuria in all cases of diabetes, though it has been shown to do so in some. Oettinger (Sem. Méd., Mar. 26, '97).

Milk may be given as an adjuvant,—a quart or so a day,—but not an exclusive milk diet. Lindsay (Boston Med. and Surg. Jour., Sept. 9, '97).

In cases of diabetes the addition of a small quantity of alcohol (1 to $2\frac{1}{4}$ ounces *per diem*) has no ill effect. In cases where there is already cardiac weakness or vascular disease, alcohol should be used cautiously. Beer is forbidden, as it contains the most extractive matters, which are chiefly carbohydrates. All sugar-containing liqueurs and sweet wines are, of course, forbidden. Wine, cognac, certain forms of brandy, etc., may be allowed. Hirschfeld (Berliner klin. Woch., Feb. 4, '95).

Literature of '96 and '97.

Eight diabetic patients could completely oxidize levulose in daily amounts of from 6 to 25 drachms. Levulose not only does not increase, but rather diminishes, the amount of nitrogenous output, both urine and fæces being examined. E. de Renzi and E. Reale (Wiener med. Woch., '97).

There are carbohydrates that seem to have little influence on glycosuria, such as levulose, inulin, and mannite. Certainly the rule is that the group of sugars which deviate polarized light to the left are less injurious than those that deviate it to the right. Bouchard (Sem. Méd., Mar. 26, '97).

Ebstein has recently very highly recommended aleuronat bread, which contains a much greater proportion of vegetable albumin than any other thus far recommended for diabetics, and which may consequently be taken in larger quantities. With regard to drinks, the abuse of beer, alcohol, and wine should be forbidden.

The above are the main features in the diet; it is necessary to conform to them as far as possible, at the same time avoiding all exaggerations.

In the severe forms of diabetes, the diet must naturally be much more limited, except in cases where coma appears imminent. The marked reaction of the

urine with the perchloride of iron, and especially the diminution of the appetite, are the chief premonitory symptoms of this danger. In such cases every one is agreed that it is well to abolish the restricted diet.

Among the medicines, opium is highly recommended.

Literature of '96-'97-'98.

Opium ranks as of the first importance. Cassoute (Gaz. des Hôp., '96).

Food stands as the great factor in the treatment of diabetes. The object for attainment is restoration of assimilative power. This is promoted by the medicinal employment of opium or its alkaloids. F. W. Pavy (Canada Med. Rec., Mar., '98).

Opium is of temporary service, at least, but I have never found it beneficial for any length of time. It causes a reduction in the quantity of sugar. Villemin advised the addition of belladonna. I have never been able to convince myself of the advantage of its use, and have found it to cause dryness of the throat. Antipyrine is sometimes most useful; it frequently diminishes excessive polyuria and reduces the sugar.

The value of antipyrine in three cases of long standing (one of twenty years') verified. The results were immediate, and all traces of the condition promptly disappeared—in one case permanently, in another for a long time after a withdrawal of the remedy; in the third case the quantity of urine at once rose to its former amount upon the withdrawal of antipyrine, but upon readministration fell again. Beginning the treatment, the medicament should be given to the amount of 31 grains, *per diem*, this amount increased by 15 1/2 grains daily until 1 1/2 drachms are reached or the amount of urine diminished; and after eight days should be omitted in order to see if the results are permanent. Opitz (Deut. med.-Zeit., Aug. 8, '89).

Literature of '96 and '97.

Antipyrine tried with the object of diminishing the amount of sugar, uric acid, and urea, but the diminution only fleeting. Beer-yeast of no use. Pancreas in the fresh state in daily doses of 30 grammes given with no better success. The corner-stone of treatment in diabetes is diet. Mousse (La Sem. Méd., Aug. 19, '96).

Antipyrine is not always indicated, however. It is only used in certain cases of diabetes, probably those in which the hyperproduction of sugar is very great, for my researches have shown that it tends rather to counteract the destruction of the sugar; moreover, the use of antipyrine cannot be long continued. Salicylate of soda has also been of service; its action is similar to that of antipyrine, with the exception that it does not equally diminish the polyuria. Quinine acts in the same way as the antipyrine and the salicylate of soda, and has the advantage of being tonic.

Sodium salicylate is especially indicated when the disease is of recent date. The drug is uncertain and only temporary results from its prolonged use. Senator (Ther. Monats., May, '94).

In one case the patient took from 2 to 2 1/2 drachms of sodium salicylate daily for two months, in all about 16 ounces of the drug; but the sugar reappeared in the urine as soon as treatment was suspended, while symptoms of salicylic intoxication also appeared, as might have been expected. Michaelis (Ther. Monats., May, '94).

Good results obtained from the use in diabetes of salicylate of sodium in large doses (1 1/4 to 3 3/4 drachms daily). Ebstein, Müller, and others (Annual, '95).

Jambul is also recommended; but in many cases it fails completely. Its mode of action requires to be further studied.

In the treatment of glycosuria, using the rind instead of the fruit in the preparation of the extract of jambul makes

it more agreeable in taste and much cheaper than the fruit. As much as 1 1/2 ounces per day can be administered for a long period without disagreeable effects. It is best given in water or wine. Vix (Ther. Monats., Apr., '93).

Literature of '96-'97-'98.

Eugenia jambolana is almost a specific in diabetes, best given in syrup or juice of ripe fruit mixed with water to form a sherbet. The powdered seeds or a fluid extract of the seeds is an exceedingly valuable form in which to exhibit it. Rudolf (Bull. of Pharm., Jan., '98).

For a number of years, particularly in fatty diabetes, I have been using permanganate of potassium: an agent which increases the oxidation. I use a 5-per-cent. solution, the patient taking 2 or 3 teaspoonfuls, or even more, per day.

Literature of '96-'97-'98.

The effects of uranium nitrate are (1) to diminish the thirst, (2) to reduce the amount of urine passed, and (3) to reduce the percentage of sugar. Like all the other drugs used in the treatment of diabetes, uranium nitrate does not influence all cases alike favorably. Samuel West (Ther. Gaz., Sept., '97).

Hepatic extract prepared as follows, should be given daily per rectum: 3 1/2 to 5 1/4 ounces of fresh pigs' liver are minced in a machine and macerated for 2 hours in 7 to 9 ounces of water at 95° to 100° F., then filtered through muslin and expressed. This amount is usually well borne as an enema; if it is not, divided doses must be given. The cases of diabetes which derive the most benefit from the treatment are those of definite hepatic origin. If the hepatic cell is too diseased, the treatment fails. Summing up 12 cases, 3 were benefited temporarily, 5 were improved permanently, and in 4 the glycosuria ceased completely. It is interesting to note that in most cases urea and uric acid are increased while liver is taken.

One deduction is certain: that the extract lessens the excretion of glucose; whether by increasing the power of storing up reserves of sugar, or by causing a more rapid destruction of ingested hydrocarbons, remains uncertain. The antitoxic function of the liver is little, if at all,—the biliary but slightly,—while the glycogenic and uropoietic functions are markedly increased. Gilbert and Carnot (La Sem. Méd., May 10, '97).

Fourteen patients treated with forms of calcium, generally as phosphate and carbonate. This treatment has apparently no effect upon the excretion of sugar, but the patient feels better and increases in weight. Of these patients three were young subjects who were markedly benefited. Upon the others there was no result. The treatment, however, produced no detriment. Karl Grube (Ther. Monats., H. 5, S. 258, '96).

1. In diabetes mellitus there is a distinct loss of phosphorus, lime, and chlorine by every form of diet.

2. Addition to diet of phosphate of lime induces a slight saving of nitrogen; addition of salt does not do this.

3. Addition of fatty matter produces the same effect as phosphate of lime.

4. Addition of phosphate of lime to the diet causes diminished excretion of sugar. W. v. Moraczewski (Zeit. f. klin. Med., B. xxxiv, H. 1, 2, '98).

Alkaline waters perceptibly diminish the sugar in the urine. Their use should consequently not be restricted, unless the patient be very much debilitated. Vichy water, taken at the springs, is particularly recommended for fatty diabetics.

Carlsbad water also appears to be useful.

For diabetic patients who are already somewhat cachectic, Bourboule water, which contains considerable arsenic, is preferable.

If the kidneys are inactive, Contrexéville should be recommended.

Independently of the use of mineral waters, it is better not to neglect baths.

Hydrotherapy may be advised for diabetic patients who are still young and, as

a rule, lotions of cold salt water in summer, and warm baths followed by friction in winter. At Aix warm douches and massage are resorted to. Generally speaking, massage is always useful for patients whose weak condition does not allow of prolonged muscular exercise. Active movements, if they do not fatigue the patient, are preferable to the passive movements. Warm climates have a favorable influence; when the patients are not greatly debilitated, mountain-air has also been recommended.

Physicians are sometimes consulted as to the advisability of allowing the use of saccharin in diabetes, to replace the taste of sugar.

Literature of '96-'97-'98.

Saccharin hinders fermentation in the intestinal tract. Boas (Med. Rec., May 7, '98).

Dyspeptic symptoms are seen after the use of saccharin; so that the substance should not be carelessly prescribed for patients, and, above all, they should not be given *carte blanche* to use as much of it as they like. Bornstein (Med. Rec., May 7, '98).

I have not seen any bad effects following its use when employed in *small doses*. An equal quantity of bicarbonate of soda should be added.

R. LÉPINE,
Lyons.

DIARRHŒA. See INTESTINES, DISORDERS OF.

DIARRHŒA, INFANTILE. See INFANTILE DIARRHŒA and CHOLERA INFANTUM.

DIGESTION. See STOMACH, DISORDERS OF.

DIGITALIS.—Digitalis is indigenous to Great Britain, Ireland, and many parts of Europe, where it grows wild on gravelly or sandy soils in young plantations, at hedge-sides, and in hill-pastures. It has been introduced into America, but is more grown as an ornament to gardens and in hot-houses than for commercial purposes, and, moreover, it is claimed that it is not so active medicinally as that obtained abroad. *Digitalis purpurea* is the official plant, though some pharmacopœias take cognizance of other forms, notably *D. Ambigua, Murr.*, which was extensively exploited by Paschkis a few years ago; and all seem to possess much the same general activity, though purple digitalis alone has been at all carefully studied.

The *Digitalis purpurea*, which is the source of all our medicinal preparations, is a biennial or perennial with numerous drooping, purple-spotted (occasionally white) or purple flowers, an erect stem from twelve to fifty inches high, and large alternate, ovate, lanceolate, crenate, rugose leaves of downy character, especially on their pale- or light- reddish-brown under-surfaces, and tapering into winged roof-stalks. The leaves, which constitute the official digitalis, should be of the second year's growth—when they are much more oval, and also more active than those of the first year—and gathered either in July or late in June, before the small, round, gray-brown seeds begin to ripen, and when about two-thirds of the flowers have expanded; they should also be dried in the dark, in baskets, over a moderately-heated stove or in a brick oven, and if properly cured will exhibit a dark-green hue and an almost total lack of odor, except that which generally accrues to dried herbs and leaves and frequently is described as "tea-like"; they have a decided nauseous and bitter taste. Much of the uncertainty that accrues to the medicinal use of digitalis is doubt-

less due to improper seasons of plucking, improper drying or packing, and age; for even the best qualities and most carefully collected and husbanded, even when pressed and wrapped in stout paper, or kept in tins that are not hermetically sealed, manifest distinct loss of remedial virtues after a few months, and may become practically inert at the expiration of a year. Digitalis-leaves, too, as found in open market, more especially the cheaper varieties, are probably not of *D. purpurea*; or the latter may be adulterated with leaves of the common potato, the black nightshade or black mullein (*Solanum tuberosum*, *S. nigrum*, and *Verbuscum nigrum*) or all three, or *Coniza squamosa*, which, in a dry state, somewhat resemble those of the purple fox-glove. Such sophistication, however, may be detected by boiling one of the suspected leaves in the smallest possible quantity of water, pouring upon an opalescent plate, and adding a drop of ferric chloride: if a green reaction occurs, the leaf is digitalis; if blue, it is not.

Preparations and Doses. — Digitalis-leaves, powdered, $^1/_2$ to 3 grains.

Digitalis abstract, $^1/_2$ to 1 grain (Squibb's, 2 to 5 grains).

Digitalis infusion (B. P.), 1 to 4 drachms (U. S. P., 2 to 8 drachms).

Digitalis extract, solid, $^1/_6$ to $^1/_2$ grain.

Digitalis, fluid extract and normal liquid, 1 to 2 minims.

Digitalis tincture (B. P.), 5 to 40 minims.

Digitalis tincture (U. S. P.), 3 to 30 minims.

Digitalis, ethereal tincture, 2 to 8 minims.

Digitalis-vinegar (G. P. digitalis, 1; alcohol, 1; vinegar, 9 parts), 10 to 30 minims.

Digitalisin (concentration), $^1/_{16}$ to $^1/_4$ grain.

Digitalein (Schmiedeberg's), $^1/_{64}$ to $^1/_{32}$ grain.

Digitaléine (Nativelle's). See DIGITONIN.

Digitalin (U. S. P. and B. P.), obsolete.

Digitalin (Homollis & Quevenne's "French Codex"), $^1/_{60}$ to $^1/_{15}$ grain.

Digitalin (Schmiedeberg's, or digitalin verum, Kiliani), $^1/_{64}$ to $^1/_{32}$ grain.

Digitaline (Nativelle's), $^1/_{250}$ to $^1/_{60}$ grain.

Digitonin (Nativelle's digitaléine), not employed.

Digitoxin (Schmiedeberg's), $^1/_{250}$ to $^1/_{125}$ grain.

DIGITALIS ABSTRACT.—This is merely a dried solid extract powdered and mixed with some material to prevent its subsequent firm agglutination, and should be made without heat by the substitute process. It presents a green color and the characteristic digitalic odor. Within a few days after making and placing in a bottle, the powder contracts very much and adheres in a fairly-solid mass that is, however, easily broken up by means of a stiff spatula, and then readily rubbed to powder again. The abstracts in market, however, vary in strength and are obsolescent.

The solid extract possesses the same odor, somewhat intensified, as the abstract, and properly made is of so dark green a hue when seen in mass as to be nearly black; but, when thinly spread, the green is very marked and intense. A brownish solid extract is suspicious and suggestive of too much heat employed in manufacture, in which case it is apt to prove inert.

INFUSION.—The infusion requires to be made with great caution and from carefully-selected leaves of bright color

and distinctive odor, also without undue heat. That of the U. S. P. is only about half the strength prescribed by the B. P.: a fact that is to be taken into account according to the residence or locality of prescriber or patient. *Fresh leaves* are nearly one-third more active than the infusion.

Fluid Extract.—A good fluid extract should represent a definite amount of drug, viz.: one gramme of leaves to the cubic centimetre of fluid. So called "normal liquid" is merely a fluid extract containing the regulation amount of drug which is also proved by assay to exhibit a uniform proportion of digitalin (total glucosides).

Tinctures. — "Concentrated" and "specific" tinctures should have the same strength as the fluid extract.

The tinctures of the B. P. and U. S. P. vary slightly: the former exhibits a strength of 3 to 24, respectively, of bruised leaves and proof-spirit; the latter 3 to 20, of drug and dilute alcohol.

The ethereal tincture is twice the strength of the U. S. P. alcoholic tincture.

Owing to the rapid deterioration of digitalis-leaves after curing, the most reliable preparations are those obtained from responsible homœopathic and eclectic pharmacists, both being in duty bound to employ the fresh leaves of the uncultivated plant in its second season when about to bloom. The homœopathic pharmacist chops and pounds the leaves to a pulp, incloses in a piece of new linen, subjects to pressure, and mixes the expressed juice by brisk agitation with an equal amount, by weight, of alcohol, the whole being then allowed to stand for eight days in a well-stoppered bottle in a dark, cool place, after which it is filtered. The eclectic macerates eight ounces of fresh leaves in a pint of alcohol (76°).

Digitalin.—Digitalin, as it formerly appeared in the pharmacopœias, is now obsolete, and where the same was used as the title of a concentration it is now replaced by digitalisin. The latter is a very uncertain production as regards strength, and consequently should not be employed.

Vinegar.—Vinegar of digitalis, which still retains a place in some Continental pharmacopœias, offers no advantages over other fluid preparations, and consequently has been dropped by the British and U. S. authorities.

Liniment. — Digitalis-liniment is merely a mixture of equal quantities of official tincture of digitalis and soap-liniment.

Ointment and Poultice.—Digitalis ointment may be made with any desirable fat and of any required strength, the usual proportions are 1 to 9 of solid extract and base, respectively. Digitalis poultice may take the form of a fomentation of the leaves, or be made by adding an ounce of the tincture to a linseed poultice.

Active Principles. — The so-called active principles consist of a number of glucosides: digitalin, digitalein, digitonin, digitin, and digitoxin. Unfortunately, great confusion exists regarding these preparations, which has been fostered by pharmacopœial errors. Thus the digitalin of Homolle & Quevenne, recognized by French authority, is an amorphous, yellowish-white powder, inodorous, intensely bitter to taste, extremely irritating to the nostrils, and highly poisonous; it is sometimes found as small scales. It is chemically a mixture of the digitalin of the German pharmacopœia and the digitoxin of Schmiedeberg. Another form that has the sanc-

tion also of the French Codex is *digitaline* (mark the final *e*) *cristallisée*, or the digitaléine of Nativelle, and appears as white, crystalline tufts or needles, and consists almost wholly of Schmiedeberg's digitoxin; it is very bitter to taste, slowly eliminated and consequently cumulative in action, and dispensed only when "crystallized digitalin" is ordered. Both the foregoing are insoluble in water or ether, but the crystallized form yields readily to chloroform and rectified spirit.

The digitalin of the German Pharmacopœia is also the digitalin verum of Kiliani. It is a white or yellowish, amorphous product, consisting of digitalein and digitoxin (Schmiedeberg's); is soluble in water, 1 to 1000 in alcohol; almost insoluble in chloroform and ether.

Digitalein (Schmiedeberg) is also an amorphous, yellowish-white powder of intense bitter taste; soluble in water and alcohol, slightly so in chloroform and ether; as before remarked, this is the chief constituent of German digitalin.

Digitoxin.—The digitoxin glucoside of Schmiedeberg is the most poisonous of all the digitalis principles and likewise markedly cumulative in action, owing to the difficulty with which it is eliminated. It occurs as a white, crystallized powder, soluble in chloroform and alcohol, slightly soluble in ether, insoluble in water.

Digitonin. — Soluble in water and alcohol, appears in the form of yellow granules, but possesses none of the properties for which digitalis is celebrated. It appears to be identical, or at least closely related, to saponin, the active principle of quilliai bark.

Digitin.—Digitin is a coarsely-granulated, crystalline powder, soluble in alcohol, ether, and alkaline solutions, and is both physiologically and therapeutically inert.

Digitaliresin. — Digitaliresin and digitoxiresin purport to be derivatives, respectively, of the digitalin and digitoxin of Schmiedeberg, but beyond this nothing is known of either.

> The Therapeutic Society ought to see that the French Codex suppresses the amorphous digitalin and admits only the crystallized. It is the only one of the digitalis products which represents a really definite principle and one of constant action and well recognized from a therapeutic stand-point. Digitoxin is not a definite principle, but of indefinite composition, variable in activity. Bardet (Les Nouveaux Remèdes, No. 2, '95).
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> Though much has been said against the constancy of action of digitalis, the fault doubtless lies in improper method of prescribing. The drug has been used with excellent effect and has proved chemically its superiority over other derivatives of digitalis in cardiac asthenia and pulmonary weakness. Massius (Bull. Acad. Roy. de Méd. de Belge, vii, '93); Corin (Les Nouveaux Remèdes, May 8, '95).

Literature of '96 and '97.

> The good results obtained from digitalis depend chiefly upon the complex constituents of the drug, and not on the presence of any single derivative. Hare (Ann. of Univ. Med. Scien., vol. v, '96).

When digitoxin is employed, it is recommended that a solution be made in alcohol, chloroform, and water, and that it be administered by clyster: digitoxin, $^1/_{96}$ to $^1/_{64}$ grain; chloroform, 4 minims; 90-degree alcohol, 1 drachm; water, to make 14 drachms; at one dose.

> The employment of the glucosides, one and all, is not to be recommended. Roth ("Mod. Mat. Med.," '95).

Physiological Action.—Though digitalis *per se* has been before the medical profession for more than three centuries,

the fact remains that its physiological attributes are by no means thoroughly understood; indeed, they constitute a subject on which there is great difference of opinion. It may be affirmed that experiments upon mammals, birds, and batrachians have added practically nothing to the knowledge already possessed regarding the action of digitalis when introduced into the economy of man. Part of the trouble may have arisen from the fact that many of the preparations as found in shops are practically inert, while the different dosage and forms of exhibition as employed by different observers inhibit uniformity. The action on the two-chambered heart of the frog, or three-chambered heart of the bird, both of which animals excrete solid urea, cannot coincide with that on the four-chambered heart and the fluid-excreting renal gland of the mammal, while, as is well known, there are few drugs toward which individual members of the human family are so generally and differently idiosyncratic. Again, the actions of watery and alcoholic preparations are by no means identical, owing to the differences in the solubility of the various glucosides in these *menstrua*; an infusion, for instance, holds in solution chiefly the digitonin, while the tincture contains digitalin and digitalein, — neither contains much digitoxin, but the tincture necessarily carries more than the infusion. Notably the infusion is more directly and promptly diuretic, and the B. P. tincture more so than that of the U. S. P., but the latter two afford the best results when the heart alone is to be acted on. But it is doubtful if the tincture alone ever acts as a true diuretic, except in the presence of a heart-lesion, such as is found in connection with some form of hydrops. The drug often fails completely in securing the desired action clinically, because the wrong preparation is employed, and it may here be noted that little reliance is to be put on the glucosides, at least not until we are possessed of more definite knowledge regarding their composition and physiological relations. Not only is their use to be deprecated, but they are generally dangerous and sometimes remedially worthless. Digitoxin especially is so highly toxic and so difficult of elimination as properly to bar it from official recognition. How often is seen the statement that digitalis is a powerful sedative, and again that it is a heart-stimulant? This conveys little information, because it is conflicting; yet it may be true, and depends solely upon the dosage, and the peculiarities of the individual patient. In fact, there is no drug in the materia medica that requires more careful handling or more careful study of effects in each and every one for whom it is prescribed; and again there is no drug more certain in securing definite results, when intelligently exhibited.

Regarding action on heart and circulation, it is deemed best to give in abstract the various views:—

> Digitalis does not diminish arterial action unless given in poisonous doses and quantities; but it has the power of lessening irritative frequency of the heart and arteries, which is accomplished by its narcotic, anti-irritant properties. Tully ("Mat. Med. and Ther.," vol. i, Part II).
>
> The action of digitalis is divided into three stages: the first is that of stimulation of the vagi; the second, sudden depression of the vasomotor apparatus of the renal arteries; third, depression of the vagus, exhaustion of the ganglia, weakening of the heart, and the circulation begins to fail. Cawasjee ("Prac. Vade Mecum," Bombay, '91).
>
> As an efficient and manageable sedative, digitalis is practically valueless;

by sedative is implied direct influence exerted upon the central organ of circulation which has caused the drug to be designated by some as "the opium of the heart." The heart is affected by digitalis in two ways: either it acts as a depressant or an antispasmodic. Munk (Guy's Hosp. Rep.).

Pressure in the pulmonary artery is reduced rather than increased under the action of digitalis at a time when the aortic pressure is enormously augmented. The importance of this is easily seen, as it implies an extraordinary physiological disassociation between the right and left heart. Bayet (Proc. Royal Acad. of Méd. Bel., fourth series, '92).

The action upon the heart is a double one in that it creates two opposing forces. By the action on the heart-muscles it steadily strives to cause contraction or systole of ventricles; by its action on the vagi it equally steadily struggles to produce diastole or dilatation of these cavities. In medicinal doses neither of these tendencies get the upper hand, for both are equally excited, so that now increased systole occurs, now increased diastole. Hare ("Prac. Therap.," '94).

The action of the drug may be summed up by saying that in moderate doses it stimulates the muscular portion of the heart (probably of its ganglia), increases activity of the inhibitory apparatus, and produces contraction of the arterioles. As a consequence of the first action, the cardiac beats become stronger; as a result of the last, there is narrowing of the blood-paths, and to the passage of the vital fluid an increased resistance which, acting on the already excited inhibitory system, aids in slowing the pulse. Decided therapeutic doses produce great reduction and sometimes dicrotism of the pulse, and increase the size and force of the wave; at the same time the arterial tension is augmented. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Digitalis lessens the number of cardiac pulsations, prolonging diastole, energizing systole, and finally paralyzing the heart in systole. This is induced by direct stimulation of the cardiac muscle, and possibly of the contained motor ganglia, as well of the peripheral inhibitory fibres of the pneumogastric. Moderate doses cause a rise of arterial pressure, probably by contracting the arterioles through stimulations of the vasomotor centres of the cord. Biddle ("Mat. Med. and Therap.," '95).

In therapeutic doses it slows the beat of the accelerated heart, regulates the beat of the arhythmic heart, and greatly augments systolic powers and the diastolic resistance. These effects are developed equally on the two sides of the heart. In relation to mechanism, the effects produced by the ventricles are not subordinate to a primary action of auricles; the action produced on the heart is not secondary to a primary action on the contractile vessels of the aortic system, as the gradual ascension of aortic pressure does not produce the same effect as the drug; and the abatement of velocity produced by digitalis resembles neither that which is produced by suspension of the activity of the accelerated nerves of the heart, nor those produced by excitation of the heart-moderators. It thus seems that the action of the drug is first manifested on the cardiac muscular fibre. François-Frank (Le Bull. Méd., July 3, '95; Jour. Amer. Med. Assoc., July 27, '95).

Germain Sée as confidently declares that the action of digitalis is greatest on the right side of the heart.

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The principal effects are upon the circulatory apparatus, the action of the drug varying according to the size of the dose. Medicinal doses cause the pulse to beat stronger, firmer, and slower, the strength of the beat being due to stimulation of the cardiac ganglia and the muscular fibres themselves. Arterial pressure is raised through stimulation of the vasomotor centre in the medulla and the ganglia situated in the muscular coats of the blood-vessels, causing a contraction of both the arteries and arterioles. This increase of arterial ten-

sion gives firmness to the pulse-beat; its slowness is due to lessened frequency in the heart-beat caused by stimulation of both the roots and ends of the cardiac vagus, and consequent lengthening of the diastolic period. Large doses may cause the pulse to beat faster and still increase cardiac pressure, owing to overstimulation of the pneumogastric and consequent exhaustion; the inhibition being removed and the heart beating under the influence of the sympathetic nerves, its beats are more frequent. The arterial tension is still high, because the mechanism presiding over the caliber of the arterioles is not so easily overstimulated as the vagus, and contracts still more, which, with the increased action of the heart, tends to increase arterial tension. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Digitalis slows the heart, increases inhibition, and stimulates motor apparatus; paralyzes cardiac ganglia by overstimulation; raises arterial tension, though slowly, possessing cumulative action. Culbreth ("Man. of Mat. Med. and Pharm.," '96).

Digitalis slows the beat of the heart; the diastole is prolonged and, while the duration of systole is not altered, its force is greatly increased; so much so that after large doses the heart becomes pale because every drop of blood is squeezed out of it. Pulse is consequently increased in force, but retarded. If a larger dose is given, the intense systolic contraction is not uniform all over the organ. The auricles and ventricles do not beat synchronously; and even one portion—the apex, for example—of the ventricle may remain spasmodically contracted during the diastole of the remainder of the cavity, causing the heart to assume "hour-glass" and other curious shapes. These phenomena are due chiefly to the direct action of the drug on cardiac muscle. Even small doses of digitalis actually increase the amount of work done by the heart in a given time. Moderate doses induce great rise in the blood-pressure; it is clear the drug contracts arterioles by direct action on their muscular coats. It also stimulates the medullary and spinal vasomotor centres. Hale White, London ("Mat. Med. and Therap.," '96).

The greatest and characteristic action of the drug is that it affects elasticity of cardiac muscle without at first modifying its contractile power, as indicated by increase in the volume of the pulse, although the absolute working power of the heart is neither increased nor decreased; at the same time the quantity of blood driven into the aorta is greater than before, not only at every beat of the pulse, but even in a given unit of of time; notwithstanding the number of pulsations be diminished, the result is a better filling of the arteries and an increase in blood-pressure. Accompanying this condition there is slowing of the pulse due to stimulation of the inhibitory mechanism of the heart. Finally, in conjunction with continuous high pressure there is irregularity both in the action of the heart and in the frequency of the pulse. Digitalis does not exert a sedative action on the muscular substance of the heart; and although the organ may be beating more slowly it may also be doing more work. William Murrell, Lond. ("Manual Mat. Med. and Therap.," '96).

Digitalis undoubtedly does affect directly—*i.e.*, immediately—the muscular tissue of the heart, including persistent contraction. Inasmuch as this action on the heart is independent of the agency of nervous tissues, it seems presumable that it may affect other muscular tissue in the same way. It does undoubtedly cause strong contraction of the blood-vessels when these are quite cut off from the central nervous control; hence it must act either directly on the muscular tissue of the walls of blood-vessels or on some peripheral nervous apparatus that governs the muscular tissue of the blood-vessels. In therapeutic use it may be conceived that digitalis will act in different ways: by strengthening the action of a weak heart; by reducing the strength of the beats of a heart acting too powerfully; by lessening the frequency of the heart's beats; by correcting irregular action of the organ; by increasing tonicity and so lessening the size of the cavities,

thereby obviating the condition of over-distension in which the stretched ventricles are unable to contract upon the contents, a condition threatening complete asystole—the second of these propositions a different and fuller dosage will probably be required. Ringer and Sainsbury ("Hand-book of Therap.," '97).

The muscular action of digitalis extends to the auricle as well as to the ventricle, although in the former it is often concealed, owing to the inhibitory mechanism having more influence on that division of the heart and there opposes it more directly than in the ventricle. Cushny (Jour. of Exper. Med., No. 3, '97).

It has been the general view that each preparation is capable of producing effects peculiar in some respects to itself. But the physiological effects of digitalein and digitoxin are identical with those of digitalin, except that they do not stimulate the vasomotor centre or the pneumogastric apparatus, and so do not directly raise blood-pressure or slow the heart. In other words, they increase the force of ventricular contraction. The effect of digitonin is to depress the vagus nerves, so it antagonizes the vagal effect of the digitalin and prevents digitalis from slowing the heart to the extent that would result from the use of digitalin alone. It also depresses the heart-muscle. H. A. Hare (Therap. Gaz., Aug. 16, '97).

Action on Brain and Cord.—It is now generally held that digitalis, in therapeutic doses, has little effect upon either the brain or the spinal cord, but earlier writers laid great stress upon its "mildly-irritant" properties as regards both, and that as it became cumulative it tended to "confuse the mental faculties." There are some observers who, to this day, ascribe the antithermic action of the drug to an effect upon the cord, whereas it becomes an antipyretic solely by its influence upon the circulation. In pyrexias there is partial vasomotor paralysis with dilated arterioles, low blood-pressure, and increased tissue-change in and around the dilated terminal vessels; consequently by contracting these vessels digitalis raises blood-pressure, it being well understood that, as the latter takes place, the temperature falls, and *vice versâ*. In other words, there is always an antagonism between temperature and blood-pressure.

While ordinary doses do not affect the brain, as the drug becomes cumulative, or it is pushed to a point approaching toxicity, the reflexes of the spinal cord seem to be somewhat lessened. As before shown, under ordinary dosage, there is probably some stimulation of the vasomotor and pneumogastric nerves.

It would appear to follow, from experiments upon frogs, that the toxic dose of digitalis primarily inhibits reflex action by stimulation of Setschenow's centre, and subsequently directly paralyzes the motor tract of the spinal cord. This influence is not, however, very apparent, even in the lower mammals, and in the human being the symptoms of poisoning are chiefly manifested in irritation of the stomach and disturbance of the circulation. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Action on Urinary Apparatus.—Under certain conditions digitalis seems to increase the flow of urine without altering, in any essential respect, the quantity or proportion of its solid ingredients; but, strange to say, this action is seldom manifested in the healthy human subject, though it is apt to be very pronounced when there is an accumulation of fluid to be removed. In truth, the manifestations of digitalis are often inconsistent and varying as regards renal secretion, and are probably in great measure indirect and secondary. As before intimated, the infusion is the most reliable form to exhibit for such purpose, and doubtless here the watery menstruum should receive a due portion of credit. That the drug is, in any sense,

adenagic or a stimulant to glandular tissue, and consequently diuretic because of such action, receives little credence these days. A fairly free use of alcoholics in connection with the infusion seems to enhance the activity of digitalis as regards the kidneys, but a better method is to combine with the latter a minute portion of cantharides.

Digitalis has no pronounced constant effect upon nitrogenous elimination. Alexëëvsky (St. Peter., Inaug. Diss., '90).

The drug increases the consumption of the chlorides, sulphates, and phosphates. Beljakow (Schmidt's Jahrb., B. 219, '91).

Digitalis increases the amount of solids eliminated in the urine, except urea and uric acid, which are diminished under its use. Biddle ("Mat. Med. and Therap.," '95).

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The effect of digitalis upon the kidney is very uncertain. Some have found that in health it is a diuretic, and some have not, and the same discrepancy in its action on the kidney exists as regards patients with heart disease, though generally in these cases it is diuretic. The reasons for these discrepancies are that, if the arterial, like the other vessels in the body, be tightly contracted by the drug, very little blood will go to the kidney, and very little urine consequently be secreted; but if the drug does not constrict the renal vessels markedly, the increased cardiac force and the general rise of blood-pressure will send more blood through the kidney and more urine will be secreted. Some state that digitalein and digitoxin have a special effect in relaxing the vessels of the kidney; and, if this is so, the question is still more complicated, for then the diuretic influence of digitalis will depend largely upon the particular preparation which is given. The truth probably is that, with a small dose, or in the first stage of a large one, the vessels of the kidney are contracted and the flow of urine diminished; but the renal arterioles, being the first in the body to suffer from subsequent arterial relaxation, dilate while the general blood-pressure is still high, and then the drug acts as a powerful diuretic. There is no certain knowledge of the effect of digitalis on the constitution of the urine. Hale White, Lond. ("Mat. Med. and Therap.," '96).

The generally-received opinion is that, of all the preparations of digitalis, that obtained by maceration possesses the most marked diuretic properties, while digitalein shows the least. This, however, is an error, and in every case the plant possesses properties very variable, according to the country in which it grows; this is shown by the great variations in dosage, and in this way may be explained the harmlessness of the very large doses used in Roumania in the treatment of pneumonia. Further than this, faulty methods of preservation and the substitution, in part, of leaves similar in appearance give rise to variations in strength. Thus, some failures which have been attributed to too great degeneration of the myocardium should rather have been laid to faulty methods of collection and preservation. For these reasons the infusion, from a pharmaceutical stand-point, should be considered as an inferior preparation to crystallized digitaline, which is always the same. An important fact, which has not been taken into consideration by those investigating the infusion, is that the leaves contain large quantities of calcium and potassium chlorides. These salts belong to that class of very diffusible agents which have a power of filtration through animal membranes, which explains their diuretic action. Huchard (Jour. des Pract., No. 48, '96).

Action as an Antipyretic.—Why toxic doses cause a fall of temperature, even in health, is one of the physiological problems that yet awaits solution; and with this depressed temperature muscular paralysis is apt to supervene.

Action on Uterus.—The muscular substance of the uterus is powerfully contracted by digitalis. It was long supposed that this action was the result of

stimulation of uterine ganglia, but it is now believed to be due to the affinity of the drug for unstriped muscular fibre. In uterine hæmorrhage, when administered, the patient (usually in about ten minutes) complains of very severe pain in the region of the sacrum, which passes into the hypogastrium, and in every respect seems to resemble the pain of the first stage of labor; very shortly afterward a considerable quantity of blood, generally in part coagulated, is forced out from the womb.

> Case of labor in which 3 drachms of tincture of digitalis was given by mistake. The drug was retained, there being only a moderate amount of systemic disturbance. A teaspoonful of fluid extract of ergot was given soon afterward. The severity of the after-pains, and the apparent antagonistic action of the ergot made the case one of clinical interest. Koehler (Med. Rec., July 6, '95).

As digitalis has been employed somewhat extensively and successfully in simple menorrhagia, its affinity for the reproductive apparatus of the female seems well established; some authors go so far even as to accredit it with phenomenal emmenagogic properties, though the evidence adduced appears to be of rather a hazy and uncertain character; and yet digitalis is employed as an ecbolic or abortifacient in some European countries.

Incompatibles. — Digitalis is incompatible in fluid preparations with salts of iron and lead; likewise with tannin and all vegetable solutions containing them. Therapeutically it is antagonized by aconite and its alkaloid, by scoparine, muscarine, saponin, staphisagria and the alkaloid of the latter, delphinine, and by drugs of the belladonna group.

Digitalis Poisoning. — Digitalis poisoning is of extremely rare occurrence: a fact that may be, oftener than not, perhaps, ascribed to the practically-inert character of most of the preparations marketed. The symptoms are, for the most part, the same as when too large or too-long-continued doses have been exhibited, but in greatly-aggravated degree: disordered state of *primæ viæ*; slow and irregular pulse; coldness of extremities; syncope or tendency thereto; giddiness; confusion of vision, external objects appearing of yellow or green hue, mist or sparks before eyes, which are prominent, with pupils fixed and perhaps dilated; weight and pain in forehead; weakness of limbs; insomnia; stupor or delirium; urine suppressed, perhaps; there may be abundant salivation. Fatality is usually preceded by stupor or convulsions and a dilated, insensible pupil.

According to Tardieu, an almost diagnostic symptom of digitalis poisoning is a blue color of the sclerotic.

The minimum fatal dose of digitalis is not known, and, owing to the inconsistency of its action, probably never will be. The treatment after evacuating stomach and bowels should be tannin, opium, stimulants, and recumbent posture; aconite may be employed, but it requires to be administered with caution.

In spite of a vast amount of evidence adduced in favor of medicinal use of the glucosides of digitalis, the fact remains that all are uncertain bodies, and that no one definitely represents the therapeutic activity of the drug itself. They are practically worthless in heart diseases. Even for hypodermic use tincture of digitalis is preferable and it is less irritating. In any event, the only glucosides worthy of attention are the digitaléine of Nativelle, or *d. cristallisée*, and the digitoxin of Schmiedeberg; even these are highly irritant to the skin and

likely to produce eczematous and other eruptions that are also often, as well, results of the use of digitalis ointments or poultices.

Therapeutics.—Digitalis is one of the most abused drugs of the materia medica.

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It appears that in the minds of a large number of the medical profession the pathological range of its application has no limitation. There is a very general want of agreement as to the conditions in which it is applicable, as well as the amount that should be considered a proper dose. Notwithstanding accepted theories and well established facts which should control its innibition, digitalis has been exhibited in every malady in the catalogue of diseases, and is consequently made the subject of unwarrantable criticism and ever-increasing abuse. One of the most universal abuses is the habit of prescribing it for a patient without advising him to abstain from exercise while under its influence. There are very few physicians who have not been disappointed by its results from the counteracting influence of exercise. All patients taking digitalis should live in perfect physical and mental quietude, as otherwise there is danger of adding to the perils of the diseased conditions demanding its use. English (Med. and Surg. Rep., Aug. 22, '96).

Diseases of the Heart.—Digitalis is, above all, a cardiac remedy; but there is as much dispute over the classes of cases to which it is applicable as over its physiological action.

Its best influence is seen in atonic states; is a very good agent in heart disease with enfeeblement. Locke ("Mat. Med. and Therap.," '95).

When the muscle of the heart for any reason is unequal to the task set it, digitalis is of incalculable service; in simple dilatation or simple failure of cardiac muscle without valvular lesion, the results of the use of the drug are most favorable. In simple hypertrophy it does harm and should never be used. Digitalis often does good in valvular lesion with enlargement of heart. In mitral insufficiency and in mitral stenosis it is often of great service. Is useful in aortic constriction; also in the irritable heart of soldiers in the early stages, but not after hypertrophy has taken place. It is of service in cardiac dropsy; in large doses in syncope or sudden collapse from hæmorrhage or other causes. H. C. Wood ("Princ. and Prac. of Therap.," '94).

In valvular lesions with very excited heart-action, irregular pulsations, increased apex-beat, and dyspnœa; also valvular lesions with weakened heart and resulting dropsy, diminished secretion of urine, dyspnœa, and a rapid, irregular, small, and flabby pulse; in nervous palpitations without valvular lesions; in Basedow's disease, simple dilatation of heart with venous engorgement, asthmatic difficulty and emphysema and dyspnœa and catarrh; weak heart-action and circulatory disturbances and their consequences occurring independently of valvular troubles—in all digitalis is useful. Roth ("Mod. Mat. Med.," '95).

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A fact that is not only forgotten, but frequently ignored, is that in normal conditions the heart-muscle adjusts itself to the demands made upon it. In those whose vocations force them into the extremes of bodily exertion, the heart becomes muscular in proportion to the demands. In response to temporary or protracted influences that perturb the heart and induce overexercise without diminution of tonicity of the myocardium, as in functional or reflex disorders, the same result follows. Digitalis is often administered under these circumstances to steady or quiet the cardiac tumult; this is a flagrant abuse of a good medicine and an unpardonable sin against the heart, and is but an added goad to an already overworked organ. Moreover, if the stomach, whence the disturbing impulses often proceed, is already irritated, the presence of digitalis will augment the difficulties in geometric ratio by increasing nausea and heighten-

ing the cephalalgia and other symptoms of gastric distress. Cardiac arhythmia of myopathic origin, or reflex, toxic, or nervous in its nature, cannot present a reasonable cause for employing digitalis. If it be exhibited in palpitation due to neurotic conditions, there will be a possibility of converting the curable disorder into an incurable malady.

In aortic regurgitation it is sometimes employed in a thoughtless and careless manner. It is a dangerous medicine and often harmful in this valvular malady. If the diastole is increased and prolonged, the period of regurgitation and its force are augmented, and the difficulties multiply.

The only excuse for prescribing it in aortic stenosis is to give vigor to the myocardium when the tendency to dilatation is pronounced. If it slows the action of the heart notably, it may add to the valvular systole or occasion tetanic contraction.

It is deplorable to employ it in conditions of compensation. Many a case of benign hypertrophy has thus been goaded into myocardial weariness and weakness that disabled the heart from keeping up its work. In the absence of dropsy, in all cases where the urine is voided freely, there is little, if any, call for digitalis. English (Med. and Surg. Rep., Aug. 22, '96).

In arteritis digitalis is a powerful auxiliary, assisting to control the morbidly increased action of the heart and arteries, but it should not be used to the exclusion of general antiphlogistic measures.

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Digitalis is indicated in deranged conditions of the circulatory system itself, and where an abnormal state of other organs may be improved by changing the circulation in them; where there is actual failure in the dynamic power of the heart-muscle, irrespective of the nature of any primary valvular lesion inducing the hyposystolic condition. Rational use presumes the absence of extensive fatty degeneration or interstitial myocarditis. It is difficult to estimate the integrity of heart-muscle, and many cases presumably intolerant to the drug bear digitalis well. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

It is generally said that digitalis does harm in aortic regurgitation, and good in obstructive mitral disease; but it is better to rely on symptoms rather than on the nature of the valvular lesions, as indications for the administration of the drug. A rough-and-ready rule, which works well in practice, is that digitalis can be given when the pulse is irregular or intermittent and the urine scanty. Remember that the freshly-prepared infusion is a better preparation than the tincture. Murrell, Lond. ("Manual of Mat. Med. and Therap.," '96).

Some consider digitalis is beneficial in mitral obstruction, while others hold it is indicated more especially in mitral regurgitation. It has been observed of eminent service in cases where, after death, the symptoms were seen to be due to mitral regurgitation, and little, if at all, to mitral obstruction. One should try digitalis in every mitral case, even in pure mitral stenosis. Inefficiency may be due to irregularity arising from fatty degeneration; and the indications for its use are less conspicuous in aortic disease with insufficient compensation than in purely mitral cases, though in failing heart from aortic disease it may render excellent service. In irritable heart where much hypertrophy exists, digitalis may prove serviceable, and may totally fail to afford any relief. It is often valuable in quelling attacks of palpitation. It is useful in fatty heart and arterio-capillary fibroses inducing hypertrophy of left ventricle. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Aneurism and Atheroma.—A number of writers have lauded the use of digitalis in aneurisms and in general capillary atheroma, with a view, as stated, of "quieting the circulation." Such, however, must be considered as open to severe censure, since increased blood-pressure may, in the one case,

tear open the thin wall of the aneurismal sac, and in the other rupture an atheromatous cerebral capillary.

The best remedy in aneurism is digitalis given in increasing doses until the pulse comes down to 50 or 45. It should be continued as long as possible. Clifford Allbutt ("Prac. of Med."); Farquharson ("Therap. and Mat. Med.," '89); Butler ("Text-book of Mat. Med., Therap,, and Pharm.," '96).

Recommended to steady and reduce heart's action. T. Holmes ("Quain's Dic. of Med.," vol. i, '94).

Aneurism and decided atheroma of vessels contra-indicate the use of digitalis. Stevens ("Manual of Therap.," '94).

If there be increased resistance to the circulation in aneurism or in general capillary atheroma, and the heart has not sufficient power to meet this, digitalis may be useful, but must be employed with extreme caution. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Contra-indicated because it increases intra-arterial pressure. Roth ("Modern Mat. Med. and Therap.," '95).

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Digitalis is contra-indicated in aneurism and all diseases accompanied by high tension, and where there are changes in cardiac muscle or atheroma of blood-vessels, except for temporary use in emergency. Foster ("Prac. Therap.," vol. i, '96).

Dropsy; Hydrocephalus.—In the dropsy of visceral disease and in the serous accumulations of inflammatory origin digitalis is often of service, but preferably it should be used in connection with some other diuretic, such as broom or squill; a minute portion of cantharides added to digitalis infusion insures a satisfactory diuretic effect. But the best results invariably accrue to administrations in the dropsy of cardiac disease and subacute nephritis. In the United States the remedy has never been employed with the same freedom as abroad; and in England and Scotland patients were formerly—and even yet in some districts—fairly drenched with an infusion made with "two handfuls" of leaves, drank *ad libitum* until ultimate narcosis, vomiting, and purging occurred. The quantity that may be given without danger is sometimes surprising, but the character of the malady in which it is exhibited should be taken into account. For instance, so satisfactory has it generally proved, in large doses, in the treatment of hydrocephalus, that many of the older practitioners to-day deem it a specific.

Nervous Diseases. — Although no direct action is produced on brain-tissue by digitalis, it may be imagined some alteration in cerebral function may follow changes induced in the vascular system; hence the apparent benefit oftentimes experienced from the empirical employment of the drug in various forms of mental alienation and in epilepsy. For nearly a century the remedy has been considered in Germany as an almost specific in mania.

The use of digitalis should be limited to those cases where the malady is dependent upon disease of the heart and particularly where there is increased fullness and pulsation of carotids and temporal arteries. Foville (Waring's "Prac. Therap.," '95).

In epilepsy, though it has produced no cure, i is evident that the use of digitalis ought not to be too hastily forsaken. In mania it is often exhibited with good effect. Barton ("Cullen's Treatise on Mat. Med.," vol. ii, '12).

Careful examination of literature reveals opinions about equally balanced as to good or ill effects of digitalis in epilepsy; it may, therefore, be concluded that the subject demands more careful and detailed attention than has hitherto been given it. In many cases detailed

it is evident that the dose employed was too small to be productive of benefit; in many more the drug, at best, was only palliative. In the north of Ireland where the drug still obtains a reputation as a specific, the doses employed are very large.

Diseases of Kidneys.—In the treatment of albuminuria digitalis has found many advocates; but, as will be readily understood on recalling its physiological relations, it cannot be held a remedy for what is at best but a mere symptom, except its activity is directed toward the primary lesion, and that referable indisputably to the central organ of circulation; and even here it should be employed only most watchfully and cautiously. Where the kidneys are involved with any morbid process having its inception in the cardiac apparatus, individual susceptibility and idiosyncrasy are likely to be highly developed. In acute stage of Bright's disease digitalis poultice and dry cupping often afford relief; and the infusion may also be employed in $^1/_2$-ounce doses, repeated every two hours for twenty-four hours, or as long as uræmic symptoms are urgent. The drug should be promptly discontinued once the urine begins to flow, and diuresis continued with the aid of mild, diluent beverages. In passive renal congestion, too, which is generally associated with cardiac disease, digitalis may be indicated.

> Digitalis is of service in granular degeneration of kidney by increasing the quantity of urine passed and lessening the amount of solids voided. It is also of service in relieving the tension of renal capillaries. Webster ("Dynamical Therap.," '93).

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> Because it is claimed that digitalis is a drug which increases the force of the heart and contracts the vessels of the periphery—except those of the kidneys—it is employed indiscriminately as an ideal diuretic in Bright's disease, notwithstanding the contra-indications observable in capillary tension and cordy pulse. Such irrational therapeutics can result in naught but harm. It seems almost foolhardy to use it in chronic nephritis accompanied with high peripheral blood-pressure, as it usually is, unless preceded by a short course of nitroglycerin to relieve the peripheral tension. English (Med. and Surg. Rep., Aug. 22, '96).

> Decidedly beneficial in chronic form of Bright's disease, where there is cardiac dilatation. In early stages of the malady, accompanied by cardiac hypertrophy and high arterial tension, it is doubtful if digitalis is indicated, either alone or in combination. Butler ("Textbook of Mat. Med., Therap., and Pharm.," '96).

Urinary Calculi, etc. — Digitalis, from its effect primarily upon the circulation, and secondarily upon the renal organs, is often a valuable adjunct to antilithic remedies. It is not itself in any sense a solvent of gravel or calculi, nor is there any evidence of remarkable power in mitigating pain or otherwise alleviating the symptoms that accompany maladies of this class; but Barton nearly a century since noted that the drug, in many instances, in a most remarkable manner relieves the troublesome dysuria which is dependent upon stone or gravel.

Cardialgia. — Here, though often recommended in doses from 10 to 20 minims three or four times daily, little can be generally expected, though by its action on the heart it may alleviate pain contingent upon some cardiac disorder.

Dyspnœa; Asthma.—In the treatment of maladies of this class, too, the drug has found a place, but in uncomplicated forms it is inferior, both as to

safety and efficacy, to other drugs. Where these are connected with disease of the heart or functional palpitation, relief may be afforded, and when accomplished the digitalis should be withdrawn, since now either opium or henbane, or both, will better answer the purpose. In spasmodic asthma it is occasionally serviceable, and it was very extensively employed in the latter part of the last and beginning of this century.

PHTHISIS.—Fifty years ago the remedy—like pretty nearly everything else at some time during its therapeutic life—was regarded as a panacea for phthisis; it was even declared that by means of fox-glove it was as possible to arrest pulmonary inflammation with as much certainty as an intermittent could be by means of cinchona or cinchonal derivatives. It is now, however, very rationally rejected as a cure, and merits only to be regarded as one of the many means occasionally useful in this malady, and which may sometimes assist more important measures. In hæmoptysis, as in other hæmorrhages, it is sometimes of great service.

PNEUMONIA. — In pneumonia, however, digitalis is often distinctively of the utmost value, particularly in maintaining the heart's action where there is adynamia, and for the promotion of the excretion of waste through the kidneys. Another fact not generally noted is that many cases of pneumonia result fatally, not from the pulmonary congestion, but from uræmic poisoning; this fact is entirely lost sight of because the attention of the practitioner is generally absorbed by the primary lesion. (Sajous.)

Of great efficacy in pneumonia when given in large doses: 60 to 90 grains are well borne given in the course of twenty-four hours. May even cut short croupous pneumonia. Of 825 cases treated since 1883 the mortality has only been 2.06 per cent. Petresco (Therap. Monats., Feb. 10, '91).

Contra-indicated in second and third stages of the disease. Bradfute (N. Y. Med. Jour., Jan. 10, '91).

Pneumonia can be cut short by an energetic rational mode of treatment with digitalis, especially if the method is inaugurated at the outset of the disease. This drug is eminently a remedy for the treatment of symptoms, and all practitioners recognize two very different types of the accompanying congestion of the lungs. Shimoneck (Med. Age, May 21, '91).

All cases of pneumonia treated with infusion of digitalis:—

℞ Digitalis-leaves, 60 to 90 grains.
Water, 52 drachms.
Simple syrup, 12 drachms.—M.

A tablespoonful every half-hour. This continued for two or three days aborts the disease and reduces the mortality to a minimum. Petresco (Trans. XI Internat. Med. Cong., '94).

[Huchard states that Roumanian digitalis may possess properties varying greatly from that of other countries. ED.]

Digitalis employed with success in the treatment of pneumonia. Zoubkowsky (Russkaia Meditzina, No. 21, '93).

In large doses digitalis is worthless. The effect on the pulse and temperature is slight, and, in view of the dangerous nature of the remedy, it is not worth the risk. Lowenthal (Centralb. f. d. Gesam. Therap., '94).

The remedy *par excellence*. Recoveries will and do occur in greater numbers when treated by large and persistent doses of digitalis. Paulison (Med. Age, Sept. 10, '94).

Seventy-four cases of croupous and thirty-four of lobar pneumonia treated with large doses of digitalis most satisfactory. Only one death: that from lobar pneumonia. Fickl (Wiener med. Woch.; Med. Age, Oct. 10, '94).

Twenty-one adults and thirteen children suffering from catarrhal pneumonia

treated with large doses of strong infusion of digitalis. The adults bore the doses well, but the children frequently exhibited evidence of gastro-intestinal disturbance. Favorable results in eighteen cases. Ordinary or small doses of digitalis have no influence upon the pulse or upon the progress of acute pulmonary disease. Strong infusions are harmless, and have very favorable influence upon the process of the disease, and may even cut it short if administered at the onset. Contra-indicated in children of one year and under, and in old people. Bloch (Wratsch, Nos. 15, 16, '94).

Often of great value in various acute diseases, such as adynamic pneumonia and adynamic fevers, by maintaining the heart's action. It can have no effect upon the diseases themselves, but may help most opportunely to sustain the heart during a crisis or a period of strain upon it. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Digitalis recommended as an antipyretic and antiphlogistic in acute febrile states with high temperature and rapid pulse, but not justly; especially is this true of pneumonia. Roth ("Mod. Mat. Med.," '95).

Experiments and clinical research lead to the belief that digitoxin, at least, has a veritable abortive action on the progress of the disease. Covin (Les Nouv. Rem., May 8, '95).

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In congestion of the lungs with high fever it is often a valuable remedy in relieving venous stasis. In the second stage of pneumonia it is of the greatest importance, being of use here to stimulate the contractile force of the cardiac muscle when the intraventricular pressure becomes stronger than the unaided muscle can resist, and dilatation is imminent, if not already begun. The main indication for the drug is the increase in intensity of the second pulmonic sound. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

If the patient is strong, under 40, with no concomitant organic disease, preference must be given to the treatment by baths; under opposite conditions, especially when the heart is feeble, digitalis should be given in doses of 45 and 85 grains of the powdered leaves a day, exhibiting it every two hours infused in water with the addition of rum and syrup of orange-peel. Slight vomiting and vertigo are not contra-indications, but the treatment must be continued till the pulse becomes abnormally slow or irregular. It is doubtful whether the enormous doses given by Petrescu are free from risk, and whether the artificial lowering of temperature by them is of real value. The maximum dose should not exceed 45 grains daily of the powdered leaves. Barth (La Sem. Méd., July 22, '96).

Digitalis is of conspicuous service in cases of febrile prostration, as in pneumonia. Has been employed to subdue acute inflammation in pulmonary as well as other tissue, and this treatment of pneumonia has been extensively practiced by Petrescu, who claims to have aborted cases in two or three days. Fairbank employs both locally and internally. Ringer and Sainsbury ("Handbook of Therap.," '97).

Pleurisy.—That digitalis may be a remedy of value in pleurisy where there is effusion, goes without saying, but some believe it is indicated at even an earlier period, on the theory that it combats hyperæmia. This, after all, is only an indorsement of the practices of Sir Thomas Watson, Aitken, and Niemeyer, who all held that the drug was especially adapted to the pre-exudative stage; and, even a quarter of a century back, the view that the drug is antiphlogistic and adenagic had by no means become obsolete.

Exophthalmic Goitre. — Digitalis has also been employed in exophthalmic goitre occasionally with considerable success.

In exophthalmic goitre it sometimes quiets the heart and lessens the pulse-rate. Stevens ("Manual of Therap.," '94).

Cases of exophthalmic goitre in young subjects, purely functional in character, have been cured by digitalein; and the cardiac irregularities and dilatation of the cervical vessels ameliorated even in incurable cases. Cawasjee ("Prac. Vade Mec.," Bombay, '91).

Digitalis occasionally proves efficient as a heart-tonic in exophthalmic goitre. Biddle ("Mat. Med. and Therap.," '95).

Patients with Graves's disease may improve under a long course of the drug, but generally this treatment fails. Hale White, Lond. ("Mat. Med., Pharm., and Therap.," '95).

ALCOHOLISM AND DELIRIUM TREMENS.—Enormous doses of digitalis are often tolerated by alcoholics, and especially those suffering with delirium tremens, probably "because the heart has by long habit become very much benumbed to the use of stimulants."

Literature of '96 and '97.

Digitalis is wonderfully effective, particularly where there is low arterial pressure. Is undoubtedly less serviceable in delirium tremens characterized by high arterial tension. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Seventy cases were treated by the late Mr. Jones, of Jersey, without the production of any alarming symptoms; but other observers were not so fortunate, and in two instances the patients fell back dead, although up to that moment there had been nothing to indicate serious danger. It must be remembered that, if a patient dies suddenly when taking digitalis, the death is always attributed to the treatment; whereas if any other drug were given the result would probably be attributed to the disease. Murrell ("Manual of Mat. Med. and Therap.," '96).

The following conclusions appear to be established: That digitalis may be given in large doses in delirium tremens without danger. That it very often does good, producing speedily, in most cases, refreshing, quiet sleep, and even when it fails it will generally calm undue excitement. That some cases appear to be uninfluenced by the drug, though there yet remains to be ascertained the forms of the disease that are most amenable thereto. Under this treatment some severe asthenic cases, in which, owing to the great prostration present, death seemed imminent, have rallied astonishingly, and ultimately recovered; the evidence of this is too strong to be disputed. Under the influence of digitalis the weak, rapid, and fluttering pulse has grown steady and strong, the skin has become comfortably moist and warm, and, simultaneously with the improvement in the circulation and state of the skin, the general condition of the patient has improved. On the other hand, personal experience in many instances has evidenced that sthenic forms of the disease are also amenable to the drug. Ringer and Sainsbury ("Hand-book of Therap.," '97).

AS AN ANAPHRODISIAC.—It has been remarked that the drug is held to be anaphrodisiac; but it is likewise accredited with aphrodisiac properties. If the supposition is true that digitalis has a direct affinity for the genital plexus, it may act either way according to dose and method of administration; it may also, in the same way, render the tissues involved either anæmic or hyperæmic. Hence it has been used in spermatorrhœa and gonorrhœa, for its effect on the minute blood-vessels of the tissues and its supposed anaphrodisiac properties.

Digitalis has a specific action upon reproductive organs, and may be used as an aphrodisiac; consequently is valuable in spermatorrhœa, and especially in nymphomania; likewise in nocturnal incontinence of urine. Goss ("Text-book of Mat. Med., Pharm., and Spec. Therap.," '89).

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Digitalis is successfully employed in spermatorrhœa and nocturnal emissions.

Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

It is a serviceable anaphrodisiac in spermatorrhœa, in conjunction with cold bathing of genitals. Foster ("Prac. Therap.," vol. i, '96).

Few remedies are of more avail in arresting spermatorrhœa than digitalis in 1-drachm or 2-drachm doses of the infusion, twice or thrice daily. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Febrile Maladies.—Every few years there appears to be an attempt to rehabilitate digitalis as an antithermic and antipyretic, and a wonderful amount of evidence favorable thereto is elaborated. The general application of the drug in this direction has been attended with many fatalities, and many more have occurred that have never found record, owing to the ignorance of the prescriber and friends of the patient. The writer saw, during one summer, three fatalities that could be traced directly to the maladministration of digitalis given as an antipyretic in mild cases of intermittent and remittent fever. In typhus and typhoid the agent has been most lauded, but all the evidence adduced in its favor will not excuse the practitioner who employs empirically only.

Hernia.—The writers of the early part of the century were wont to recommend the use of this drug in very large doses for the reduction of incarcerated hernia. Thirty years ago appeared in the Lancet, London, a statement that if suppuration of a gland have begun, digitalis would prevent the formation of abscess. This is undoubtedly true in many instances, owing to promotion of increased absorption and elimination.

G. Archie Stockwell,
(Central Staff).

DIIODITHYMOL. See Aristol.

DILATATION OF THE HEART.

Definition.—Increase in the size of the heart, due to enlargement of one or more of its cavities. Clinically, "dilatation" is applied to an enlarged, but failing, heart displaying the phenomena of "ruptured compensation."

Literature of '96 and '97.

The term "dilatation" should be reserved for cases attended with degeneration of the muscular wall, and the word "distension" or "expansion" for dilatation in purely physiological cases. Instead of "hypertrophy with dilatation" where there is no structural alteration, "hypertrophy with distension" or "hypertrophy with expansion" would be employed. James Tyson (Boston Med. and Surg. Jour., Sept. 9, '97).

Varieties.—"Simple" dilatation is the term used to denote that condition in which the walls of the heart remain of comparatively normal thickness. Inasmuch, however, as the cavities, and consequently their walls, are more extensive than normal, simple dilatation is associated with a certain amount of hypertrophy. Dilatation is "hypertrophic" when the heart-walls are thicker than normal. Another name is "active" dilatation; and viewed from the opposite stand-point it becomes "eccentric hypertrophy." In "atrophic," or "passive," dilatation the walls are thinner than normal.

Most cases of dilatation are essentially chronic in their development and progress. Some, however, are acute.

Symptoms.—Usually the earliest indication to the patient of his trouble is shortness of breath. This at first is apparent only upon exertion, but in well-developed cases it becomes a source of great suffering. Hardly more than one word can be uttered without a pause for breath; and sleep, if obtained at all, is possible only in the vertical position

(orthopnœa). The ordinary automatic respiration has sometimes to be supplemented by voluntary efforts; so that when sleep does come the dyspnœa becomes aggravated and soon wakes the patient.

Another early symptom is palpitation with a sense of discomfort or oppression in the cardiac region. It is singular that the powerful heave of an hypertrophied heart does not seem to obtrude itself upon the consciousness of the patient so much as the feeble flutter of dilatation. There may also be a cough, with white, frothy, serous expectoration. The poor circulation in the brain is evidenced by more or less mental slowness and easy fatigue, with impaired memory, despondency, ill-temper, and attacks of faintness. In the digestive tract the passive congestion of the stomach is evidenced by fermentation, heaviness, nausea, and even vomiting. The bowels are usually sluggish, and the urine is scanty and high-colored, with a deposit of urates.

In mild degrees of dilatation the complexion is pale, in more advanced cases dusky or cyanotic with blue lips and finger-nails. The extremities are apt to be cold to the touch, and the sluggishness of the capillary circulation is illustrated by the slow return of color to any point of the surface after firm pressure: the shape of the examiner's hand is, as it were, stenciled upon the cyanotic surface. The labored breathing is noticed even while the patient is at rest, but becomes striking upon the least exertion. Œdema invades first the ankles, thence creeps upward to the thighs and pudenda, and finally invades even the face and arms. Ascites and hydrothorax are often present. It is not unusual to find a considerable amount of fluid in one side of the chest, while the other presents merely the signs of œdema. The eyes are somewhat prominent and glassy. Frequently the liver is much enlarged, reaching even to the level of the navel. This change in its size may be more or less obscured by the ascites present, but in that case can often be demonstrated by a quick, though gentle, pressure of the fingers inward (ballottement). In some cases the spleen is also found to be enlarged.

> Four cases of fatal cardiac dilatation, involving especially the right side of the heart, in which orthopnœa was never present. Acording to Hilton Fagge, the absence of orthopnœa is characteristic of right-sided affections, but no satisfactory explanation of this fact has been given. It would appear that the upright position gives relief chiefly in failing compensation in valvular disease and in the failing heart of renal disease, but that in dilatation, especially when the right side is affected, and in degenerations of the cardiac muscle, as in anæmia, after fevers, diphtheria, and septic poisoning, the tendency to faintness produced by the upright position more than counterbalances any other advantages. Handford (Lancet, June 25, '92).

The pulse is of great importance both in regard to diagnosis and prognosis. It is apt to be frequent, ill-sustained, and irregular in both force and rhythm. The number of radial pulsations may be considerably less than the number of heart-beats as counted with the stethoscope. The pulse-wave is apt to be small, but in cases where previous high tension, as in arteriosclerosis, has dilated the peripheral arteries, the wave may be of considerable volume. Any approach to tension in the arteries is of favorable import.

The phenomenon known as bigeminal pulse is quite frequent in cases of dilatation. Often the second and weaker of these twin cardiac impulses fails to reach the radius in perceptible strength. Inspection of the cardiac region shows no such bulging as may be present in cases

of hypertrophy, except when the precedent hypertrophy has left its traces behind it. It may be difficult to locate the apex-beat by the eye, or the impulse may seem to be diffuse and not to impinge upon exactly the same point with every beat.

Over other portions of the heart than the apex the intercostal spaces may sometimes be seen to protrude and recede with the action of the heart, and sometimes an extensive wavy motion may be observed over the cardiac area. When the right ventricle is dilated, there is more than a usual amount of impulse in the epigastrium below and to the right of the xiphoid cartilage.

Upon palpation the heart-beat is found not to be of a strong and heaving character, but feeble and resembling a quick tapping or slapping of the chest, sometimes with more or less of a tremulous sensation imparted to the hand. Even when the eye has detected the apex-beat, the hand may not be able to distinguish it. The most satisfactory mode of practicing palpation is by resting the whole hand, as lightly as possible, over the præcordium, and then testing the impressions thus received by firmer pressure and by digital touch.

Percussion shows an increase in the area of cardiac dullness varying somewhat according to the portion or portions of the heart mainly dilated. Increase in the size of the right ventricle makes the heart broader than normal, but not much longer. The right limit of dullness may, in such a case, reach or even extend beyond the right nipple. Enlargement of the right auricle is associated with increase of dullness at the right edge of the sternum, corresponding to the second and third intercostal spaces. The dilated left ventricle presents an area of cardiac dullness not much wider toward the right than normal, but extending downward to the seventh or eighth intercostal space, and perhaps an inch or two to the left of the normal position of the apex.

By means of auscultation we may, in the first place, be able more exactly to locate the position of the apex-beat than by either inspection or palpation, assuming that it corresponds to that point where the first sound of the heart is loudest. The first sound of the heart in cases of dilatation may be louder than normal, but it is devoid of muscular quality, being short and valvular; that is, closely resembling the normal second sound of the heart. It is heard with more distinctness in the aortic area than is the first sound of the hypertrophied heart. Frequently there is also heard a systolic murmur at the apex, due to regurgitation through the mitral valve or tricuspid, because the auriculo-ventricular opening is dilated as well as the ventricle, and consequently has become too large for the valve, even though normal, to close it efficiently (relative insufficiency). The second sounds at the base of the heart are of variable character in different cases. If they are tolerably sharp and distinct they are somewhat reassuring, as indicating that the ventricles still possess muscular power. Another important point (W. H. and J. F. H. Broadbent) is the length of the pause between the first and second sounds of the heart as compared with the pause separating one cardiac cycle from another. If the first and second sounds are separated by a shorter interval than in health, we must infer that the dilated ventricles are able to make only an ineffective effort at systole, while, if there is a longer pause between the first and second sounds of the heart, it is evident that the cardiac muscle still possesses sufficient vigor to make a prolonged ef-

fort to overcome the obstacles which it meets in propelling the blood-current.

When tricuspid regurgitation exists, the veins in the neck are dark and turgid. Their valves show like knots. Often actual pulsation in them may be demonstrated, especially if the patient takes a horizontal position. Pressure upon the congested liver magnifies the engorgement of the jugulars.

Diagnosis. — From pure hypertrophy dilatation can be clearly distinguished by the general aspect of the patient, and the evidences of imperfect and failing circulation already detailed. In both conditions the area of cardiac dullness is increased, but in dilatation we do not observe the strong heaving impulse of hypertrophy. In general, it may be said that the two are opposites. Hypertrophy is an exaggeration of the normal state, while dilatation is a condition of weakness and failure.

The first sound of the hypertrophied heart at the apex may not be so loud or distinct as in dilatation, being low and muffled, and, as already stated, it may be inaudible at the base; but there is present in it a muscular quality, distinguishable in a less degree over the apex of a normal heart, and not heard in cases of dilatation.

The hypertrophied heart must at last, however, enter into the state of dilatation,—unless its owner is the victim of intercurrent disease,—and the important practical question for diagnosis in most cases is to determine what degree of deterioration has already been reached and how much longer the circulation can be maintained.

Very valuable information in doubtful cases with regard to the integrity or otherwise of an enlarged heart may be obtained by causing the subject under examination to make somewhat brisk muscular exertion, as by ascending and descending a flight of stairs or by hopping six or eight yards upon one foot. The degenerated heart will become unnaturally accelerated and irregular, while a well-nourished heart will act even better than before.

In certain cases retraction of the lung, as in chronic phthisis, leaves a comparatively-normal heart more exposed than in health and might occasion a mistake of the condition for one of dilatation. Factors in this diagnosis would be the history of the case, the signs of pulmonary disease, the absence of venous stasis in other parts of the body, and the fact that the border of the lung near the heart did not extend inward over the cardiac area on full inspiration, as under normal conditions it should.

Mediastinal tumors may cause dullness in the cardiac region, but they are apt to extend upward and to the right or left side; and the heart-sounds are not audible over them in the same way as over the dilated heart. In thoracic aneurism we should expect to find a heaving impulse in the neighborhood of the base of the heart, with other positive signs of aneurism and without the changes in the cardiac sounds and impulse or in the general circulation seen in dilatation.

A more difficult question is to distinguish pericardial effusion from cardiac dilatation. In certain cases this seems to the writer almost impossible, although in the great majority of instances a definite conclusion can undoubtedly be reached. In pericarditis we are more apt to have a history of an acute onset with fever and pericardial friction-sounds, and perhaps, also, knowledge of a nephritis or tuberculosis or acute pneumonia as etiological factors in the production of pericarditis.

The pericardial effusions give an area

of dullness somewhat more pear-shaped than that seen in dilatation of the heart, which is, more or less, quadrilateral. Pericardial effusion also raises the apex-beat upward and outward toward the third or fourth spaces in the neighborhood of the left nipple, and it renders the heart-sounds less distinctly audible than in dilatation. It may also cause a paradoxical pulse. Yet, in case of valvular heart disease with a fresh attack of rheumatism, a recent pericarditic friction-sound, and evident failure of compensation, it may be very difficult to determine whether the increased area of dullness on the right side of the sternum is referable to pericardial effusion or to dilatation of the right ventricle.

In the cases already spoken of there has been a question of mistaking the enlarged area of dullness in the cardiac region due to other causes for a dilated heart. There is a contrary danger in cases of emphysema that a dilated heart may not be recognized because of unnatural pulmonary resonance encroaching upon the true cardiac area. Here we may be saved from error by the history of chronic bronchitis, and of already-established and slowly-increasing dyspnœa, as well as by the characteristic pulmonary signs.

Etiology.—Increase in the cavities of the heart must be due either to abnormal weakness of their walls or excessive labor in the propulsion of the blood-current. Among obstacles to the circulation should be enumerated valvular disease, arteriosclerosis, chronic interstitial nephritis, atheroma, and congenital narrowness of the aorta. Contrary to what might be presupposed, thoracic aneurism does not cause change in the heart-walls, unless associated with aortic regurgitations. Pericardial adhesions may cause dilatation of the heart, more especially when the outer surface of the pericardium is fastened to the chest-wall or diaphragm.

Exophthalmic goitre and tachycardia cause cardiac dilatation, as may also excesses in tobacco and venery, great anxiety and despondency, leukæmia, and chlorosis.

> Causes in 360 cases: Arteriosclerosis in 59 per cent.; chronic nephritis in 13.4 per cent.; valvular lesions in 12.4 per cent.; adhesions in the pericardium in 7.6 per cent.; excessive muscular work in 3.8 per cent.; tumors in 1.9 per cent.; aneurisms in 0.95 per cent. Lafleur (Montreal Med. Jour., May, '95).
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> Principal causes, other than disease of the valves, myocardium, and pericardium: 1. Organic changes in arterial system. 2. Overfilling of circulation. 3. Foreign substances in the blood. 4. Causes that act on general cardiac nervous system. Arteriosclerosis the most important factor. J. Stewart (Montreal Med. Jour., Apr., '95).

Habitual severe and sustained physical exertion may cause cardiac dilatation, as seen in both athletes and in men following laborious occupations. Sudden dilatation may, indeed, ensue upon a single violent or prolonged muscular effort. In many cases of this sort it is presumable that the myocardium was previously in a vulnerable condition; but yet dilatation may occur in young and apparently healthy men after mountain-climbing, and, after a period of due rest, be completely recovered from. In other cases, however, especially in persons with less elasticity of constitution, the lesion is a permanent one and progresses to a fatal termination.

> Cycling tells primarily and distinctively on the heart and circulation. Benjamin Ward Richardson (Asclepiad, Third Quarter, '94-'95).
>
> Several subjects in which death had occurred from heart-strain. Marked dilatation of coronary veins and their sub-

epicardial branches. Microscopically, dilatation seen to extend to capillaries between individual muscle-bundles. Intermuscular connective tissue granular and cloudy. Muscle-cells showed vacuolar degeneration. Venous congestion and œdema of muscular bundles and connective tissue. Banti (Centralb. f. allg. Path. u. path. Anat., B. 6, Nos. 14, 15, '95).

In ten runners, who had just reached the goal, apex seemed to have deviated to the left from two to three centimetres. In one, affected with aortic insufficiency, apex lowered and notable increase of præcordial dullness, evidently connected with dilatation of right cavities. Among all the men arterial pressure lowered. Mechanism seems to relate to overtaxing, general fatigue, and to secreted toxic products. Teissier (Le Bull. Méd., Dec. 19, '94).

Excessive work thrown upon normal right ventricle presents fairly-distinctive symptom,—namely, pain, localized in the region of the second and third left costal cartilages; usually dull, but may be acute; sense of tightness in præcordia. In the adolescent type of dilatation increase of size upward and to the left, giving increased area of relative cardiac dullness in third, second, and sometimes first left interspaces. F. Stacey Wilson (Birmingham Med. Rev., Sept., '94).

Segmentary dissociation of the myocardium in a fatal case of strained heart. Fibre seemed to have its continuity broken at the level of the intercellular cement. Félix Ramond (Le Bull. Méd., Dec. 8, '95).

Literature of '96-'97-'98.

Pulse after violent use of bicycle in some cases reached 250; after ten hours' rest, heart still accelerated: a sign of beginning insufficiency. Mendelssohn (Med. Press and Circular, Jan. 15, '96).

Study of the lesser degrees of cardiac weakness and dilatation. After fatigue the heart is in a temporarily-relaxed condition, similar to that of the skeletal muscles after severe exertion. After wrestling the heart may be temporarily dilated, and, as the pulse indicates, may contract with much diminished force. The temporary and physiological relaxed condition of the organ merges by intermediate degrees into one of actual dilatation. Clinical observations indicating three phases of pathological relaxation of the heart:—

1. A premonitory stage characterized by palpitation, excitability of the heart's action, feeling of fatigue, and slight anxiety. Cases of this kind should not be regarded as merely nervous. As etiological factors the following are mentioned: Rapid growth at puberty, sexual excesses and masturbation, physical and mental overwork, mental troubles, anæmia, alcohol and nicotine, fatty infiltration, previous illnesses, and premature old age.

2. The first stage of actual relaxation. This is divided into an acute, a subacute, and an intermittent form; such cases are often labeled as cardiac neurasthenia.

3. This class embraces the ordinary cases of actual dilatation, on which so much has been written.

The early stages should be especially sought for. The early stages of cardiac dilatation should be recognized, just as much as the early stages of pulmonary tuberculosis, so that the condition may be opposed in time. Concordance with Gerhardt and Fräntzel that palpation is more important than percussion for estimating the size of a relaxed heart. One must feel in the intercostal spaces for the left ventricle several times and with the patient in different positions, but especially in the leaning-forward position made use of by Gumprecht. Whitwicki and Seeligmüller have observed a marked difference in respiration accordingly as the patient lies on his left or his right side. This may be an important symptom of dilatation of the left ventricle. In one case was noted on repeated occasions an increase of twelve to twenty inspirations in the minute when the patient turned from his right on to his left side. L. Feilchenfeld (Brit. Med. Jour., from Berl. klin. Woch., Feb. 28, '98).

Case in a bicylist who had been in the habit of taking prolonged rides and who had accomplished several century-runs. Marked hypertrophy and dilatation of

the heart, the latter being predominant. In addition a systolic murmur was audible over the cardiac area, with its greatest intensity at the apex. The patient readily becomes dyspnœic; the heart-beat is ordinarily 38 to 40, but under the influence of the slightest excitement or exertion it increases to 80 or 90. J. M. Taylor (Phila. Med. Jour., April 16, '98).

Several cases of acute dilatation of the heart from bicycling witnessed. Explanation referred to the lack of the aspiratory action of the heart during the ride, and the excessive pumping action of the muscles of the extremities exerted on the veins and lymphatics,—both of which lead to a distension of the right heart. F. A. Packard (Phila. Med. Jour., Apr. 16, '98).

Other causes are acute nephritis, as after scarlet fever, rheumatic pericarditis and myocarditis, pneumonia, and typhoid fever. Influenza certainly may precipitate dilatation, if it does not actually cause it.

Defective development of thorax important in the etiology of pseudohypertrophies of adolescence. Thorax elongated and constricted; heart forced downward, apex sometimes as low as fifth intercostal space. Huchard (La Semaine Méd., Nov. 3, '94).

Connection between kidney disease and cardiac hypertrophy attributed to primary toxicity of the blood. De Dominicis (Wiener med. Woch., Nov. 17 to Dec. 1, '94).

Rôle ascribed by some authorities to ordinary growth in production of organic cardiac conditions, notably hypertrophy, cannot be demonstrated. Potain and Vaques (La Semaine Méd., Sept. 25, '95).

Ingestion of a pint of water causes blood-pressure to return to normal in one hour; after ingestion of pint of wine or beer blood-pressure becomes normal only after two hours. Great beer-drinkers nearly all suffer in a few years from dilatation of the heart. Bollinger (Med. Press and Circular, Aug. 28, '95).

High tension in the systemic arteries, aortic stenosis, and aortic regurgitation cause a predominant change in the left ventricle as compared with the other cavities.

Results of examinations of 139 vessels of all sizes. In smaller arteries thickening affecting both muscular and fibrous coats. Thickening greater in small vessels than in larger. With chronic granular kidney hypertrophy of the muscle and of the fibrous tissue of whole arterial system connected with left side of the heart and of muscles of the heart. W. Howship Dickinson (Lancet, July 20, Aug. 3, '95).

In aortic regurgitation the dilatation is beneficial with certain limits. Inasmuch as a certain portion of the blood pressed into the aorta with each systole is at once allowed to return to the ventricle, the total amount of blood pressed out with the systole must be greater than in health, or there will inevitably be a diminution in the normal amount in the arterial system. In its final development aortic insufficiency presents dilatation of all the cavities of the heart. In case of mitral regurgitation there is also dilatation of the left ventricle, because a leak in the mitral valve during systole overdistends the left auricle, and during diastole the blood rushes into the left ventricle under more than normal tension, enlarging its cavity. The usual and chief effect of mitral lesions, however, is enlargement of the right side of the heart: at first of the right ventricle, and, when it begins to fail, also of the right auricle. The right auricle seldom undergoes much hypertrophy; any increase in its size is apt to be a pure dilatation.

Hypertrophy is never primary in a hard-working heart, whether increased labor be due to resistance from within, from without, or to nervous stimulation and augmented action. Primary dilatation is a compensatory element. Residual blood dilates the cavities, and diminishes the extent to which each

fibre is called upon to contract. J. G. Adami (Montreal Med. Jour., May, '95).

The stress of initial stenosis, pulmonary stenosis, and chronic pulmonary disease falls upon the right side of the heart. Predominant dilatation of the right ventricle makes the heart globular in shape.

Temporary dilatation of the heart may occur under both physiological and pathological conditions. It cannot be explained as only apparent and ascribed to the action of respiration, for ordinary respiration does not sensibly modify the area of the cardiac dullness, and may occur four or five times in a minute. The phenomenon may be explained by suddenly increased intracardiac pressure or by diminished tonicity of the ventricular wall. G. Sée (La Méd. Mod., June 4, '91).

Reticulated condition of the myocardium observed in the case of a woman afflicted with mitral obstruction and regurgitation, who died, at the age of 40, after eighteen months of chronic asystole. The interstitial spaces of the myocardium were found to be dilated without signs of an inflammatory process The author's explanation is that a chronic interstitial œdema had stretched apart the muscular fibres, and that the condition was a result of venous and lymphatic stasis. Maurice Letulle (Bull. de la Soc. Anat., No. 25, '93).

Literature of '96-'97-'98.

Acute dilatation of the heart occurring in the course of cancrum oris. The area of cardiac dullness had rapidly extended, the apex was beating an inch and a half external to the nipple, and over area there was heard for the first time a loud, blowing, systolic murmur. The principal point of interest in the case is the rapidity with which the heart dilated. When the patient came under observation it was noted that her heart was healthy and its area of percussion normal. In the course of the illness the apex of the heart could be seen getting carried farther and farther daily, and all at once a mitral systolic murmur developed, and the pulse became rapid and irregular. The heart dilated owing to malnutrition of the myocardium, either from fever or from the poisoned blood, and the mitral systolic murmur that developed was adynamic rather than endocarditic. Thomas Oliver (Edinburgh Med. Jour., Mar., '98).

An examination of the minute structure of the myocardium in dilatation may show either interstitial myocarditis or fatty degeneration, or there may be no change in the heart-fibres appreciable even with the microscope. In certain of these cases it would seem probable that the nervous ganglia connected with the heart may be at fault. In marked dilatation the pectinate muscles themselves are flattened into mere tendinous cords.

[The accompanying illustrations are from photographs of specimens in the Warren Museum in the Harvard Medical School, for advice and assistance in obtaining which I am indebted to the courtesy of Dr. William F. Whitney, Curator. HERMAN VICKERY.]

Prognosis.—It will be seen from what has gone before that dilatation of the heart is a condition which it is not proper to generalize when considering any individual case. The state might be said to bear the same relation to heart conditions that jaundice holds to the liver and digestive tract. Each case should, therefore, be carefully considered on its own merits or demerits.

The most acute transitory form of dilatation is probably that which occurs in athletes and others under great or long-continued effort. The majority of these persons, if in good health and well trained, seem to escape permanent injury. It will be found, however, that a certain important proportion of those who engage in violent and desperate competitive physical exertions, as for instance, a long boat-race, suffer for years thereafter from discomfort in the cardiac

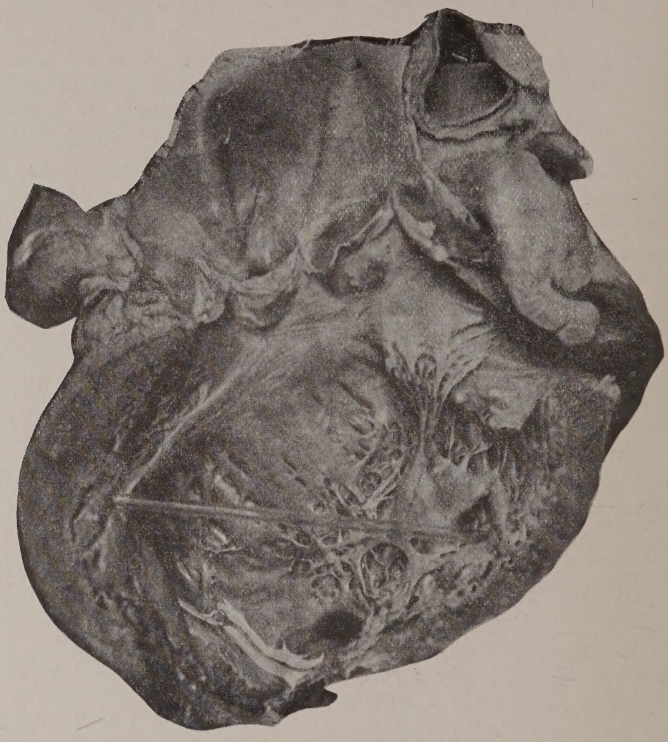


Fig. 1.—Dilated left ventricle with a cardiac aneurism at apex. Case of chronic interstitial myocarditis in a man aged 84.

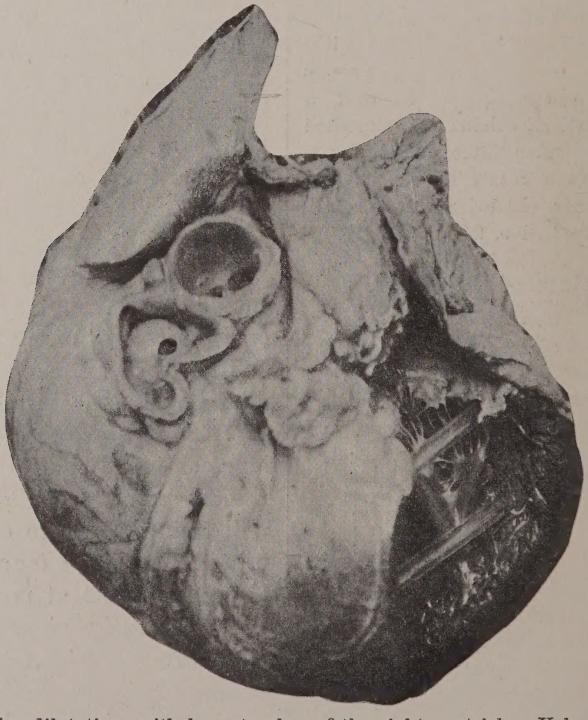


Fig. 2.—Excessive dilatation, with hypertrophy, of the right ventricle. Valves of pulmonary artery united to form a smooth fibrous diaphragm with a small opening in the centre. Left ventricle laid open, not enlarged. Case of a boy aged 14. Cyanosis, dyspnœa, sudden death.

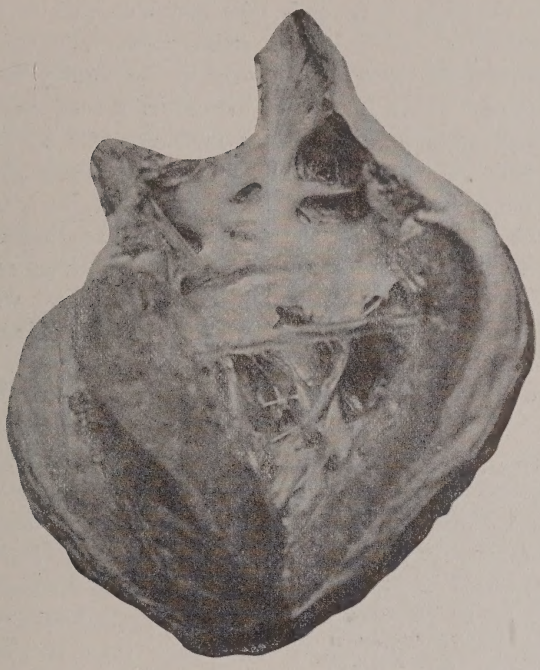


Fig. 3.—View of right ventricle of same heart.

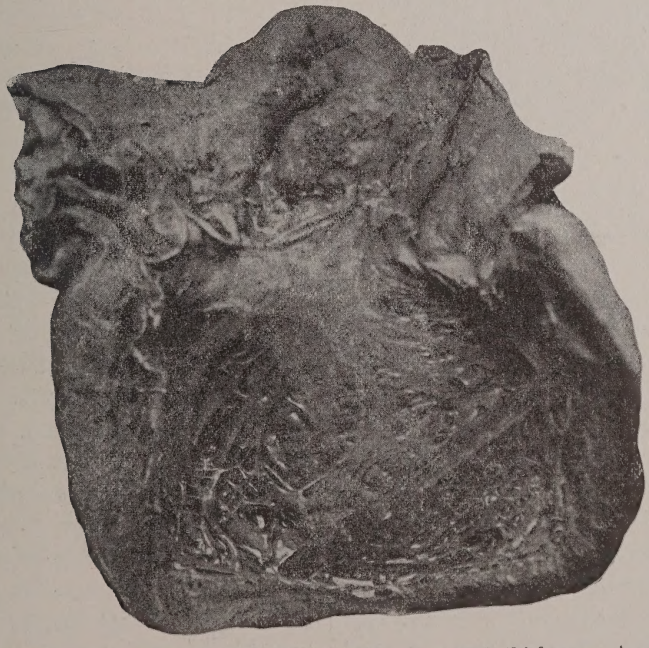


Fig. 4.—Left ventricle greatly dilated, but its walls of normal thickness. Aorta extremely atheromatous and enlarged. Man aged 44. Cardiac symptoms of pain, dyspnœa, and palpitation for ten years. Death in a seizure.

region, with some tendency to irregularity of the pulse.

Those who train athletes should appreciate this possibility. The first degree of dilatation and consequent venous stasis is shown by pallor, for this reason: as the left ventricle becomes tired, blood accumulates in the right side of the heart and the systemic veins in more than normal amount, yet not exceeding the capacity of the venous system. As a consequence of this increase of blood in the venous channels, there is less

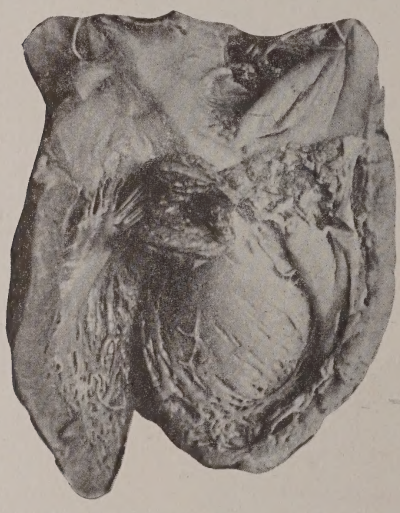


Fig. 5.—Dilated left ventricle showing trabeculæ flattened and indistinct. Mitral valves extensively destroyed and covered with large vegetations.

blood than normal in the arteries, causing a pallor which does not advance to cyanosis until a much greater amount of blood is present in the veins. If, then, a person engaged in vigorous exercise changes from the ordinary pink flush of countenance to a decided pallor, the limit of safe exertion has been reached. Cyanosis conveys a still more inperative warning.

With regard to the more common and usually slowly-developing forms of dilatation, it should be said that there may be many degrees of the disease in different persons. Here, too, sudden progress in the wrong direction may occur, as the result of overstrain,—changing a moderate into a severe case. In general, it may be said that the patient does not often survive a well-marked condition of cardiac dilatation for more than twelve or eighteen months.

The factors upon which we should lay weight in determining the reserve power of a dilated heart are of two kinds: rational and physical. If the disease has come on in one whose habits can be greatly changed for the better, with regard either to overindulgence in alcohol, tobacco, the pleasures of the table, and such like, or sorrow, anxiety, overwork, and long hours of sustained effort, then the chances are somewhat more favorable than if the subject has led a physiologically blameless life. The judiciousness or unsuitableness of the treatment heretofore adopted should also be considered. And those who have previously undergone one or two attacks of cardiac failure are to be regarded in a more dangerous condition than during their previous illnesses.

Irregularity in the pulse is not necessarily of evil import, but a great frequency of the pulse-rate is discouraging. Of course, any degree of vigor in the cardiac impulse is a welcome discovery, as is also a sharp and decided quality in the second sounds at the base of the heart. The case may be considerably affected in its course by our ability to obtain for the patient a fair degree of sleep and maintain a sufficient nutrition of the body.

It is oftener possible to produce a certain degree of improvement than to maintain it, to say nothing of completing the recovery.

A fatal termination may be preceded

by attacks of syncope, often most alarming; but death is more apt to come at the end of a comatose condition than with extreme suddenness. Embolism and thrombosis may also prove terminal factors.

Treatment.—Absolute rest in bed is very desirable if the patient is able to enjoy it. In many cases, however, the sufferer cannot assume the horizontal position, but is obliged to sit either propped up in bed or in a chair where he may bend his knees. For such unfortunates, sleep is often best obtained by providing them with a shelf or rest in front of them at about the level of the elbows, on which they may lean, bending forward. There are special tables made with a leaf reaching over the bed.

> In dilatation and hypertrophy resulting from overexertion, in marked cases, rest in bed important factor. Stimulants to be avoided. Digitalis useful in many cases, but rejected by some stomachs. In such cases rectal injections of the drug. Calomel if other cardiac remedies fail. Narcotics and hypnotics to be used with great care, but sometimes necessary, as sleep rests the heart. Ice-bags of doubtful value. Blood-letting to prevent stasis, especially for relief of cyanosis and distressing dyspnœa. Use of aërated beverages to be avoided. Herman (Deutsches Archiv f. klin. Med., B. 55, p. 8, '95).

The diet is of nearly equal importance with bodily rest. It should be bland, easily digested, and given in small amounts at intervals of two or three hours. Some cases have seemed to do well on a purely-milk diet, particularly such as have suffered from high arterial tension. In most, however, a variety of rather concentrated, but simple, viands is preferable. Thus we may allow eggs, fowl, underdone beef or mutton, beef-juice, and gruels made with one-half milk and one-half water. Alcohol as a beverage or long-continued tonic is useless and harmful. It should be reserved for emergencies, unless, indeed, the patient has become so accustomed to it that a small amount of whisky or dry wine is almost necessary to stimulate the appetite and digestion. It is the view of some that habitual alcoholic stimulation is more desirable in old age than in earlier life; but the writer's experience has satisfied him that, in the condition under consideration, great caution should always be used in regulating the administration of alcohol.

Constipation and flatulence interfere with abdominal respiration and impede the venous circulation. Laxatives are consequently of great value, and more especially hydragogue cathartics. Enlargement of the liver increases the advisability of their employment. In suitable cases the relief from a purge is almost magical. It seems to produce the same mechanical effect that venesection would without the loss of strength which the latter measure involves. The favorite drug is mercury, either in the form of blue mass or the mild chloride. This may be followed the next morning by a dose of sulphate of magnesium or sodium in concentrated solution. It is said that the advantage of mercury over other cathartics is that it not only depletes the veins, but dilates the capillaries, and thus lessens the obstruction which the weakened heart has to overcome. Another efficient and not very unpleasant remedy for the same purpose is composed of equal parts of bitartrate of potassium and compound jalap powder, of which the dose is 1 or 2 teaspoonfuls. By far the best cardiac stimulant in this condition is digitalis. It should be given in efficient doses. If the desired effect is not obtained with ordi-

nary amounts, the remedy should be gradually pressed until either there is improvement or nausea interferes with its further administration. In some cases it may be given by means of an enema when the stomach altogether rejects it. Its well-known cumulative action should be remembered, and it should not be longer continued if nausea begins or the amount of urine diminishes. In fact, practically, one must be ready to suspend it about as soon as it produces a marked satisfactory effect (see DIGITALIS). As substitutes for digitalis, tincture of strophantus, caffeine, and sulphate of sparteine may be employed, their probable efficacy being in the order named.

> Sparteine is the most prompt and effective drug in diminishing the volume of the heart. It increases the tonicity of the cardiac muscle. Digitaline acts principally on the cavities of the right side, and only in cases of pathological dilatation. Iodide of potash also diminishes the volume of the heart, but less than sparteine. Antipyrine and bromide of potash increase the volume of the heart and are contra-indicated. G. Sée (La Méd. Mod., June 4, '91).
>
> Pellets of cactina, $^1/_{100}$ grain each, one being given every two hours during the day; especially effective in weak and dilated heart. Kola cordial as a cardiac tonic. Campbell (Montreal Med. Jour., June, '95).

Strychnine is often of great value and may be combined with any of these or given independently. Iron is useful for its beneficial effect upon the nutrition of the heart-wall. Quinine and arsenic are advised in certain cases. It is hardly safe to give the latter to subjects in whom fatty degeneration is suspected. On the other hand, arsenic sometimes appears particularly efficient in cases where there is cardiac pain.

Massage may do good in two ways, both by promoting general nutrition and by assisting in the propulsion of the blood. The Schott method of treatment may be of advantage in less-alarming cases where there yet remains some muscular integrity in the heart. Oertel's method of treatment is suitable in so far as the amount of liquid ingested may often be limited to advantage, but unsuitable with regard to the forced muscular effort he advised. Climbing is more useful for obesity with fatty overgrowth of the heart than for conditions of cardiac dilatation. Accumulations of fluid in the abdominal or thoracic cavities should be withdrawn. It is sometimes surprising how much benefit will follow the removal of twelve or sixteen ounces of water from the chest or a few quarts from the abdomen.

In well-marked cyanosis with considerable enlargement of the liver half a dozen leeches may give relief. They may be applied directly over the liver and the subsequent bleeding should be encouraged by warm, wet compresses.

> With signs of dilatation as indicated by gallop rhythm, urgent dyspnœa, and slight lividity, venesection is in many cases the only means by which life of the patient may be saved; 20 to 30 ounces of blood to be abstracted without delay. Osler (Montreal Med. Jour., June, '95).

The legs in some instances are immensely distended with fluid. Bullæ are apt to form, which burst spontaneously and exude dropsical fluid. Large amounts of water may sometimes be drawn from the lower extremities through Southey's capillary trocars or by means of longitudinal scarifications. A practical objection to the latter method is the great danger of erysipelas attacking the scarified tissues. Apart from that, the constant dripping day and night torments the patient and soon causes more or less eczema of the skin.

But the relief to the circulation is, in some instances, worth even the immense amount of trouble and the considerable risk thus entailed.

For the attacks of syncope to which these patients are liable, the subcutaneous injection of digitalis, nitroglycerin, ether, alcohol, or strychnine is necessary. Marked relief and apparently valuable stimulation are sometimes obtained by the inhalation of oxygen-gas, which has once or twice seemed to the writer actually life-saving in its efficacy. In such cases, however, a fatal termination is merely delayed, not absolutely prevented.

HERMAN VICKERY,
Boston.

DILATATION OF THE STOMACH. See STOMACH, DISORDERS OF.

DIPHTHERIA. — From the Greek: *διφθέρα*, a skin or membrane.

Definition.—Diphtheria is an acute infectious and contagious disease produced by the presence and development of the Klebs-Loeffler bacillus. As it occurs in man, it is usually characterized by the presence of false membranes upon the surfaces primarily attacked, especially the mucous membranes of the nose, pharynx, larynx, or trachea. There can no longer be any question of the specific relation between the great majority of cases of the disease known since the time of Bretonneau as diphtheria and the bacillus with which Klebs and Loeffler have identified their names. The bacillus is regularly obtained in cultures from affected throats; it can readily be isolated; and when pure cultures are injected in animals they reproduce the essential features of the disease met with in man. Welch and others, by inoculating the mucous membranes of guinea-pigs, have even succeeded in producing the false membranes so closely associated with the disease in man. All the constitutional effects and characteristic lesions, except the formation of membrane of diphtheria, have likewise been produced by the injection in animals of the toxins produced by the specific bacillus. In experimental diphtheria, induced either by the injection of cultures of the Klebs-Loeffler bacillus or of its toxins, the most striking feature is the production in animals of the paralyses due to nerve and muscular degenerations, such paralyses reproducing most exactly the phenomena so often observed in clinical diphtheria. This feature of the experimental process has so impressed itself upon those most interested in laboratory researches that some propose to define diphtheria as an acute infectious disease, produced by the action of the Klebs-Loeffler bacillus, and characterized by the development of nerve-degenerations.

While this teaching may be most in harmony with the combined evidence of clinical observation and laboratory research, it does not yet seem advisable to so far depart from the conceptions of diphtheria which have heretofore obtained. The appearance of false membrane has long been regarded as almost diagnostic; it still belongs to the great majority of cases, and can readily be appreciated, while the nerve-degenerations, if they appear at all in clinical diphtheria, are met with only in the later stages of the disease, long after the question of diagnosis will have been determined.

Varieties.—The classification of the acute inflammations affecting nose, throat, etc., has not yet reached a satisfactory stage. The distinctions based upon the presence or absence of pseudomembranes have lost their significance.

While the great majority of pseudomembranous inflammations of these parts are due to the action of the diphtheria bacillus, a considerable number of such inflammations are produced by the action of other bacteria, especially the streptococci and staphylococci. On the other hand, the action of the diphtheria bacillus is not always attended by the production of pseudomembranes. The intensity of the local action of the bacilli varies greatly, and it has been found that this diphtheria bacillus may be the cause of simple inflammatory processes, formerly designated as catarrhal, which present no appearance of false membranes. Moreover we find that the all-important question in any case, both with reference to prognosis and treatment, is the presence or absence of the diphtheria bacillus. We, therefore, abandon the former classification into catarrhal and pseudomembranous processes and speak of:—

1. *Diphtheria*, or *true diphtheria*, in which we include all cases of acute inflammations affecting mucous membranes associated with the presence of the diphtheria bacillus in sufficient number to constitute a probable causative agent. Thus, if a culture from a sore throat show the presence of the diphtheria bacillus, that case is at the present time accepted as diphtheria, whether there be or not pseudomembrane present, and no matter what other bacteria be associated in the culture with the diphtheria bacillus. It must, however, be noted that the presence of the diphtheria bacillus without further clinical evidence does not constitute diphtheria any more than the presence of pneumococci in the mouths of healthy persons constitutes pneumonia.

Cultures from 330 non-diphtheritic throats gave, in 22, virulent Loeffler bacilli; in 21, non-virulent characteristic bacilli; and, in 28, Hoffman's pseudobacilli. W. H. Park (Med. Rec., Aug. 18, '94).

During a diphtheria epidemic virulent diphtheria bacilli found in 17 cases in the mouths of 89 healthy subjects. In a scarlatina ward infected by 1 case of diphtheria, bacilli found in 20 per cent. of children with scarlet fever without diphtheritic infection. Aaser (Deutsche med. Woch., No. 22, '95).

Literature of '97 and '98.

In an epidemic of diphtheria recurring again and again in a public school, the throats of all the scholars—134 in all—were examined. In 22 of the persons bacillus diphtheriæ, or bacteria resembling those, were found in the mucus of the throat, but only in 8 were true bacilli of diphtheria found, while in 10 cases the short bacilli of Martus and in 4 cases long bacilli were present, which did not grow in the cultures in the same manner as the bacilli of diphtheria. Fibiger (Hospitalstidende, p. 93, '97).

Systematic bacteriological examination of the buccal secretion of every child, for three days after admission to the wards conducted during an attack of diphtheria among hospital children. The examination was made for the purpose of proving whether the child was infected with the diphtheritic bacillus before or after admission to the hospital. Out of 100 children examined, and of whom none presented any trace of stomatitis, the diphtheritic bacillus was discovered in 24. At this time there were 4 children suffering from diphtheria in the ward.

In 20 other children the bacillus was found present in 6 on admission, and in the other 14 cases it was discovered at times varying from a few days to several weeks after admission. The infants in whom these bacilli were present in the mouth presented no symptoms, either general or local. These bacilli often remained for several weeks, and even months (in one case two and a half months), in an indolent condition, although in several cases they declared themselves in a virulent manner. Of the

6 children who arrived at the hospital with diphtheritic bacilli already in the mouth, only 1 came from a family in which there had been a case of diphtheria five weeks previously; 2 came from a house infected by measles, and the remaining 3 had not been in contact with any cases of infectious disease. In 12 cases the bacteriological examination was supplemented by inoculation of animals. The bacilli found in 6 cases were so virulent as to cause the death of the animals in from twenty-four to forty-eight hours, while in the other 6 cases the virulence was only of medium intensity. Heubner (Jahrb. f. Kinderh., B. 43, S. 54).

2. *Pseudodiphtheria,* in which we include all cases resembling diphtheria but not showing the presence of the diphtheria bacillus in cultures from the affected parts. Such pseudomembranous inflammations are commonly seen as complications of the acute infectious diseases, especially scarlet fever and measles. Cultures from such cases regularly show the presence of streptococci or staphylococci or both. The streptococci are especially frequent. Pneumococci and other bacteria have been found.

The site of the diphtheritic process, whether nose, tonsils or pharynx, or larynx, materially affects the symptoms and course of the disease; we therefore, in our description, speak of *nasal*; *pharyngeal, or tonsillar*; *and laryngeal diphtheria.* In the effort to further classify their cases some divide them upon the basis of the bacteriological findings in cultures from the throat. Thus, when the culture shows diphtheria bacilli practically alone, they designate the case as bacillary diphtheria; when cocci are present in considerable numbers with the diphtheria bacilli, as coccobacillary diphtheria, etc. This method would be highly satisfactory did the clinical course and outcome of the disease correspond to the bacteriological findings, but they do not. The presence of cocci in the cultures does not show that they will play any important part in the disease, and the complications produced by their action—such as pneumonia and nephritis—seem to be as frequent in cases that give apparently pure cultures of the diphtheria bacillus from the throat as in those that show many cocci as well. When we have to do with a systemic infection with streptococci as well as the diphtheria bacilli, we speak of the cases as "mixed infections"; but the distinction is based upon the clinical symptoms of the disease and not upon the results of the bacteriological examination. We find it most advantageous to divide the cases into mild, severe, or septic, according to the character of the symptoms presented.

Corresponding to these three forms of diphtheria, Monti presents a classification based upon the character of the exudate in the throat:—

1. A fibrinous form in which the diphtheritic products are only placed upon the mucous membrane, not incorporated with it. Virchow, Weigert, and Cohnheim call this the croupous form.

2. A mixed form, called also the phlegmonous form, in which the fibrinous exudate lies deep in the tissues as well as upon the mucous membrane.

A septic, or gangrenous, form, in which a fibrinous pseudomembrane is formed in the deep tissues of the mucous membrane, the process really consisting of a necrosis of the tissues and a mingling of the dead particles with the diphtheritic products.

Similar classifications are presented by other Continental writers; but we have not yet found it of advantage to attempt

to classify our cases by the local appearances of the throat. Certainly the distinctions that Monti makes call for very nice and rather difficult discriminations.

Symptoms. — These vary sufficiently with the site of the lesions to make it of advantage to consider the local forms separately.

1. Nasal Diphtheria. — Diphtheria of the nasal cavities is, in most cases, simple extension from the fauces, or larynx. It may, however, occur as a primary affection. It is characterized by more or less complete obstruction of the nares; a thin, muco-purulent, and often bloody discharge from the nostrils; and a more or less marked toxæmia. Pseudomembrane may be developed and may be visible through the anterior nares, but, as a rule, we see no membrane. The nasal discharge is usually very irritating and the nares become excoriated.

The degree of the toxæmia varies markedly. Usually it is very moderate, the temperature is not high (100° or 101°), the prostration is not marked, and the chief danger of the cases seems to lie in an extension of the process by continuity of tissue, to the pharynx or larynx, or the development of pneumonia.

The affection is often protracted, the discharge from the nose and the obstruction persisting for weeks, despite careful treatment.

Lennox Browne reports a total mortality of 63.4 per cent. in a series of cases of diphtheria involving the nose, and attributes to the nasal affection more importance than to the laryngeal. Few writers or clinicians can agree with this opinion. In practically all the cases of the series reported other parts were involved besides the nares, and the mortality-record is a tribute to the gravity of extensive diphtheria rather than to the danger of the nasal affection alone. In infants, however, nasal diphtheria frequently proves fatal. It may readily be the origin of a pharyngeal or laryngeal process. It may, furthermore, be the means of communicating the disease to others.

2. Pharyngeal, or Tonsillar, Diphtheria.—(*A*) *Mild Cases Without Membrane, or Catarrhal Diphtheria.*— During the prevalence of an epidemic of diphtheria, especially in institutions, a certain number of cases may be observed in which, without the appearance of pseudomembrane, the pharynx and tonsils become reddened and somewhat swelled, the children complain of slight soreness of the throat and have a rise in temperature, but do not appear or feel very ill; yet cultures made from such throats show the presence of the diphtheria bacillus. Such cases we have learned to class as true diphtheria. The mildness of the affection is attributed either to the small number of bacilli present, to a diminution in the virulence of the bacilli, or to an increased resistance on the part of the patient. In many of these cases the nose is involved as well as the pharynx and tonsils, and there is consequently a thin, watery, irritating discharge from the nostrils. In the course of a few days all symptoms subside, and the bacilli disappear, or they may persist for weeks without further symptoms.

> Series of 20 children in which the bacillus was found in 6 on admission, while in the other 14 cases it was discovered at times varying from a few days to several weeks after admission. The infants in whom the bacilli were present in the mouth presented no symptoms, either general or local. These bacilli often remained for several weeks, and even months (in one case two and a half months), in an indolent condition, although in several cases they declared

themselves in a virulent manner. Of the 6 children who arrived at the hospital with diphtheria bacilli already in the mouth, only 1 came from a family in which there had been a case of diphtheria five weeks previously; 2 came from a house infected by measles, and the remaining 3 had not been in contact with any cases of infectious disease. In 12 cases the bacteriological examination was supplemented by inoculation of animals. The bacilli found in 6 cases were so virulent as to cause the death of the animals in from twenty-four to forty-eight hours, while in the other 6 cases the virulence was only of medium intensity. Heubner (Jahrb. f. Kinderh., B. 43, S. 54).

Literature of '96 and '97.

Diphtheria bacilli may exist in the throat for months after an attack, and they may occur in the healthy pharynx. Cases of chronic exudate are, however, much less common. The following illustrates the latter: A 19-year-old servant-girl became ill with general symptoms and an ulcer on the right half of the soft palate, in the secretion of which virulent Loeffler bacilli were found. During the next five months there continued to be an exudate in the pharynx in which virulent diphtheria bacilli could always be demonstrated. The bacilli were characteristically influenced by the Behring serum, while it had no effect on the exudate. The blood-serum of the patient protected twenty times more than normal serum against injections of Loeffler's bacilli. F. Jensen (Centralb. f. inn. Med., No. 19, '97).

The bacilli derived from cultures from such cases may prove to be fully virulent, and any such case may readily be the means of communicating a severe or virulent type of the disease to others.

The patients themselves may show albuminuria during the course of their mild attack, or they may later develop the paralyses belonging to the severer types of diphtheria. The latter outcome is, fortunately, rare.

From the catarrhal process in the throat and nose there may arise by extension a diphtheritic laryngitis either catarrhal or pseudomembranous in character, which may be followed by stenosis or other grave symptoms.

(*B*) *Mild Cases, with Membrane, of Pharyngeal, or Tonsillar, Diphtheria.*— These cases are characterized by the development of more or less pseudomembrane upon the tonsils, fauces, or pharynx, and a moderate toxæmia. The onset of the trouble is marked by sore throat; a moderate fever, 100° or 102°; and a slight prostration. Upon examining the throat we usually find one or both tonsils reddened, swelled, and presenting upon their surfaces one or more patches of pseudomembrane. These patches may be small and difficult to distinguish from the yellow plugs seen in follicular tonsillitis. The membrane is usually firmly adherent to the underlying tissue, and, if removed, leaves a bleeding surface. The area covered by membrane may sometimes be marked off from the surrounding tissues by a zone of congestion. The membrane is usually white-gray, or grayish-green in color, sometimes yellow, and the patches are of irregular form. It is sometimes thick and heavy, sometimes so thin as to be translucent. Over against this description of diphtheritic membrane we might set the characters of pseudomembrane not diphtheritic, but the more painstaking the description, the more evident would it become that it is perfectly impossible to distinguish one from the other by simple inspection. Nothing short of a bacteriological examination will enable us to make the distinction with certainty.

The presence of the Loeffler bacillus is a sure sign that the accompanying pseudomembranous inflammation is diph-

> theritic; the bacillus of diphtheria may be present without causing symptoms of the disease; the bacillus may disappear when the symptoms cease, or may continue in a virulent state for months upon the fauces of the infected person. Loeffler (Lancet, Sept. 8, '94).

With such appearances in the throat there is usually a distinct swelling and tenderness of the submaxillary and cervical lymph-nodes.

The extent of membrane in the mild cases is usually limited, and there seems little tendency toward spreading; but, on the other hand, we may see cases in which tonsils, fauces, and pharynx are covered with membrane and yet the constitutional depression is slight.

After the onset in a mild case the membrane may extend somewhat, so as to involve the fauces or pharynx; but may remain limited to the tonsils. The throat continues sore, the temperature shows some elevation, and the children feel moderately sick. In the course of three to five days the membrane begins to separate, either gradually or in masses, the throat clears up, the temperature falls, the glandular swelling subsides, and in a week or so the patient is well again.

A mild diphtheria may be accompanied by albuminuria, and may be followed by nephritis or paralysis, but, as a rule, the cause is benign and the outcome satisfactory. We must, however, be prepared at any time to see an apparently mild case of diphtheria change character and become a virulent infection. From a mild tonsillar, or pharyngeal, diphtheria a severe diphtheritic laryngitis may be developed.

The most troublesome features of these mild cases of diphtheria is the difficulty of maintaining proper quarantine. If adults, the patients do not regard themselves sick after the first day or two, and can hardly be made to understand that even when well they may be the source of grave danger to others.

If the patients are children, the parents find it difficult to take a serious view of an apparently trifling sore throat and are often unwilling to take the necessary precautions to prevent the spread of the disease. It cannot be too emphatically laid down in such cases that the clinical phenomena are no test of the virulence of the bacteria present. From an apparently mild case Para obtained the most virulent bacillus he has yet met with, and employed its toxins in the production of antitoxin of unusual strength. It has likewise long been well-known that an apparently mild case of diphtheria may communicate a malignant infection to others.

The mild cases should be quarantined just as faithfully as the most severe, and should be allowed freedom only when the specific bacteria have disappeared from the throat.

(*C*) *The Severe Cases.*—In these the manner of onset may be sudden, with chill, vomiting, fever, and severe sore throat, the temperature rising to 103°-104°, and the prostration being marked, or the affection may begin as a mild case and gradually develop the severe symptoms, the invasion being very insidious. If seen at the beginning, there may be little membrane visible in the throat, only a small patch or two upon the tonsils, exactly similar to that described in the mild cases; the throat will, however, be more reddened and the swelling more marked. The submaxillary and cervical lymph-nodes will be swelled and tender. The child looks and acts sick. The elevation of temperature may not be in keeping with the degree of constitutional depression, oftentimes being only 101° to 102°. As the disease develops, the membrane rapidly extends,

until the tonsils, pharynx, uvula, and fauces are covered with a thick gray, green, or even black layer of necrotic material. If any effort be made to remove it the underlying tissues bleed freely. The membrane fills the rhinopharynx, involves the nasal cavities, and may even appear in the nares. With the involvement of the nose there is seen a thin, acrid, often bloody and foul-smelling discharge from the nostrils. The membrane may also invade the mouth and appear upon the lips. In one case seen at the Foundling Hospital, the extent of gray membrane upon the lips, cheeks, and tongue was so marked as to suggest the possibility that the child had been drinking carbolic acid. Mechanical removal of the membrane in such cases does no good whatever; it seems only to open up a fresh surface to the attack of the virulent bacilli, and the membrane is reproduced with almost marvelous rapidity. At any time the inflammatory process may involve the larynx, giving rise to laryngeal diphtheria, or it may involve the middle ear through the Eustachian tubes; in rare cases by extension through the lacrymal duct or by accidental inoculation the conjunctiva is involved.

With the increase in the local process the lymph-nodes of the neck become more swelled and tender, until it seems that they will surely suppurate, but they rarely do so. The constitutional depression becomes more and more marked. The pulse becomes more rapid and feeble; the strength fails steadily.

Literature of '96-'97-'98.

Eight hundred consecutive cases of diphtheria observed. Less than half of the cases in which the pulse-rate exceeds 100 recover. The pulse-rate and the mortality appear to be very much in a direct ratio to each other, and recovery is improbable when the pulse gets above 150. Extreme slowness of the pulse is less significant; but in children bradycardia does at times presage evil. Variations of rhythm and volume occur in some 10 per cent. of all cases, and are a useful premonition of cardiac complications. A systolic murmur at the apex of the heart is heard in about one case in ten; its significance depends entirely upon its cause. This is far more commonly mitral insufficiency, due either to weakness and inadequate contraction of the cardiac muscle, or to dilatation of the left ventricle, but in rare instances to an endocarditis of diphtherial origin. Hibbard (Boston Med. and Surg. Jour., Jan. 27, Feb. 3, '98).

The temperature may not at any time be very high, 101° or 102°, or it may reach 103° or 105°. The swelling and tenderness of the throat render swallowing painful and sometimes almost impossible. The tonsils may almost meet in the median line, the nostrils may be plugged and even respiration seriously interfered with. At times in the early days of the disease we may see fluids regurgitate through the nose, when any attempt to drink is made, and it may be difficult to determine whether the regurgitation is due to the obstruction of the throat by the swelled tonsils or to an early paralysis of the pharyngeal muscles.

As the diphtheria advances, the urine becomes scanty and high colored, and contains albumin in some quantity; at times an acute exudative nephritis is developed, with large quantities of albumin, casts, and even blood. The onset of the complication may bring, in its train, all the symptoms of an acute nephritis.

Examinations made for albuminuria in 279 cases of diphtheria, it being found in 131,—rate of mortality, 50.37 per cent. No evidence of albuminuria could be discovered in 148 cases,—the rate of mortality here being 14.2 per cent. Cases

free from albuminuria thus afford a more favorable prognosis. Baginsky (Archiv f. Kinderh., B. 16, H. 3-6, '93).

The mind may remain clear throughout; but, as a rule, with the deepening of the toxæmia the patients become dull and listless. In the severest cases stupor or delirium may be developed. Coma is rarely seen. Convulsions may occur either early or late in the disease, from the toxæmia of the diphtheria or from uræmia.

In some cases the patients die from the diphtheria toxæmia alone; but in most of the fatal cases one or the other of the complications is the direct cause of death. Most important of these is the pneumonia. Although most often seen in laryngeal cases, pneumonia is a common sequel of diphtheria, either nasal or pharyngeal. The onset of the broncho-pneumonia is usually marked by a decided rise in the temperature, a quickened respiration, and some cough. Not till the pneumonia has advanced to the consolidation of large areas do definite physical signs attest its presence. Usually we hear more or less numerous fine crackling râles over one or both chests posteriorly. Later there may be scattered areas of dullness, with bronchial voice and breathing. For evidence of the onset we must depend upon the rational rather than the physical signs. The development of pneumonia is always a grave and often a fatal complication. In but few fatal cases do we fail to find a more or less extensive involvement of the lungs, and in the greater number it plays an important part in the unhappy outcome.

If the view at present generally held, that the complicating pneumonia is dependent upon the action of streptococci and not upon that of the diphtheria bacillus itself, and therefore antitoxin can only indirectly affect its onset or its violence, be true, then the problem of further reducing the mortality of diphtheria must depend upon the solution of the prevention and treatment of this complication. At present it is of importance to watch for signs of its onset and to be prepared to take measures to limit its extension and enable the patient to bear the attack. The most malignant cases of diphtheria die within forty-eight hours of the onset of the disease, and even in these we find more or less extensive areas of broncho-pneumonia. Most of the fatal cases terminate after five or ten days, the patients being exhausted by the toxæmia of the disease or the pneumonia.

In the more favorable cases improvement usually begins about the fourth or fifth day. The change is shown in both the blood and the general condition. In the throat the membrane ceases to extend and begins to separate. The separation begins upon the edge of each patch, the separated portions forming loosened tags in the nose or throat, or the membrane may come away *en masse* in the form of casts of the affected parts. The surface beneath the membrane is at first raw and bleeding, but is usually quickly covered by new epithelium. On the tonsils, however, ulcers are formed, which, healing slowly, leave irregular, depressed areas of cicatricial tissue, giving to the tonsils the excavated appearance so often seen after severe diphtheria. With the separation of the membrane the purulent discharge from nose and mouth gradually ceases, but a catarrhal secretion may continue for weeks afterward, such catarrhal secretion still containing virulent bacilli.

With the change in the local condi-

tion the temperature gradually falls, the pulse improves, the glandular swellings subside, the dullness or stupor disappear, and at the end of the second or third week the patient is convalescent. The patients are usually left very anæmic, and the return to health is likely to be slow.

From time to time we see cases in which the formation of membrane continues for two or three weeks, the course of the disease is protracted and recovery correspondingly delayed. In other cases the broncho-pneumonia persists long after the disappearance of all evidences of the diphtheria, and may either cause death from exhaustion or may slowly dissolve.

3. Cases of Mixed Infection, or Septic Diphtheria.—Under this head are grouped those cases in which bacteriological investigation shows the presence of the diphtheria bacillus, together with other pathogenic bacteria, usually streptococci, in some cases pneumococci, and in which these additional organisms seem to exert a definite influence upon the course of the disease. Most of these cases are fatal and in post-mortem examinations systemic infection with streptococci or pneumococci is said to be found. The appearance of the membrane in these cases does not differ essentially from that seen in the severer forms of infection with the diphtheria bacillus alone. It may be white, yellow, gray, or olive colored, or, where hæmorrhages accompany the inflammatory process, more or less black. The membrane is usually extensive, covering the tonsils, pharynx, fauces, and uvula. The swelling of the affected parts is usually very marked, the œdema being pronounced, the tonsils often so filling the throat as to preclude examination of the pharynx and giving rise to dysphagia and dyspnœa. There is the same muco-purulent or bloody discharge from the nose and mouth; the nares are obstructed and the patients often breathe only through the mouth. A peculiar sickening, sweetish fœtor is characteristic. The lymphatic nodes and cellular tissues of the neck are most commonly swelled and indurated, the process in many cases leading on to suppuration and occasionally to gangrene. The pressure upon the veins of the neck may produce congestion of the head and swelling of the face. The swelled, dusky features, with the sanious discharge from nose and mouth, is characteristic and impressive.

The constitutional symptoms are those of a profound septicæmia. The temperature often runs as high as 104° or 106°, but may not be remarkable. The pulse is rapid, feeble, and compressible. With the feebleness of the pulse, the extremities may be cold and pale, in marked contrast to the dusky face. Vomiting and diarrhœa are common, and may be persistent. The urine contains considerable albumin and casts, and in some cases blood. The quantity may be diminished; suppression may occur and cause death from uræmia. Œdema of feet or hands may be seen. The liver and spleen may both be enlarged. The cerebral symptoms are marked. The patients are usually dull and stupid, indifferent to their condition or surroundings, but at times they are delirious and extremely restless, tossing continually from side to side or crying out as though in pain. Broncho-pneumonia is very common and usually hastens death. At any time during the course of the disease the larynx may be involved by extension. The cases, as a rule, terminate fatally within a week, sometimes within forty-eight hours.

Rapid failure in the strength of the heart marks the fatal progress of the disease, and the end may be brought about by sudden and unexpected syncope. If they survive the first violence of the infection, these cases are especially liable to complications attributed to the pathogenic action of the streptococci, such as suppuration of the cervical lymph-nodes and cellular tissues, broncho-pneumonia, and nephritis.

Literature of '96 and '97.

Results of the examination of 234 cases of membranous angina bacteriologically:—

1. Loeffler's bacillus was absent in 26 cases, there being present staphylococci, streptococci, pneumococci, and bacillus coli communis. Two died,—1 of meningitis. Excluding this 1, the mortality was 3.84 per cent.

2. Loeffler's bacillus occurred alone in 102 cases; mortality 28,—27.45 per cent.

3. Loeffler's bacillus found in association with the staphylococcus pyogenes in 76 cases; mortality 25,—32.89 per cent.

4. Loeffler's bacillus found with streptococcus pyogenes in 20 cases; mortality 6,—30 per cent.

5. Loeffler's bacillus with streptococcus and pneumococcus (Fränkel's) in 7 cases; mortality 3,—43 per cent.

6. Loeffler's bacillus with bacillus coli communis found in 3 cases, all of which ended fatally. De Blasi and Russo-Travali (Riforma Med., Nos. 179, 180, '96).

4. Laryngeal Diphtheria. — The clinical picture of laryngeal diphtheria does not present such variety as is seen in diphtheria of the pharynx and tonsils. The local effects, due to the anatomical form and structure of the larynx and its physiological function, predominate over the constitutional symptoms. The mucous membrane of the larynx possesses but little absorptive power; so that as long as the diphtheritic process is limited to the larynx the toxæmia is slight.

From what has been already said it is evident that we may have laryngeal diphtheria:—

1. As a primary affection.

2. As an extension of a process beginning either in the nose or the throat.

It may also occur:—

3. As a complication of other infectious diseases, especially measles or scarlet fever. In the latter relation it is less common than the pseudomembranous laryngitis produced by the action of staphylococci or streptococci (pseudo-diphtheria), and occurring as a complication it presents itself in one of the two preceding ways, either primarily, or secondarily to diphtheria of the nose or throat.

Diphtheria of the larynx begins gradually with a hoarse cough and voice, and perhaps a slight stridor with inspiration. The temperature is usually low,—99° to 101°,—and the child does not appear very sick. The early stages are not to be clinically distinguished from acute catarrhal laryngitis, except that the onset of the latter is usually more abrupt and the temperature higher,—102° to 103°. The course of diphtheritic laryngitis has the following rather characteristic sequence of symptoms: Croupy cough, croupy inspiration, aphonia, stridulous expiration, suprasternal and infrasternal recessions, restlessness and jactitation, and cyanosis. The cough becomes more and more hoarse, the voice, at first hoarse, fails steadily until the aphonia becomes complete; the stridor, at first only affecting inspiration, shows itself with expiration and becomes louder. With the increase in the local symptoms, the temperature may continue low or may mount step by step to 104° or more. At the end of the first or second day the

symptoms of laryngeal stenosis become well developed. The voice is sunk to a whisper or lost altogether, the cough is very hoarse and short (tight), there is loud stridor with both inspiration and expiration, and every effort to fill the chest grows slower and more labored. With each inspiration there is more or less marked depression of the suprasternal, and supraclavicular spaces and the epigastrium. The finger-tips are blue, the lips livid, the face pale, the forehead and perhaps the whole body bathed in perspiration as the child struggles to overcome the increasing obstruction to respiration. The perfect clearness of mind is in marked contrast to the dullness or stupor usually seen in severe types of diphtheria elsewhere. As the agony increases, the child sits up, supporting the shoulders by the arms to give free play to all the accessory muscles of respiration, or, wild with fear, throws himself from side to side or up and down in a vain effort to shake off the tightening grip upon his larynx. It cannot be too strongly laid down that the laryngeal stenosis seen in these cases is largely the result of spasm of the laryngeal muscles excited reflexly by the inflammatory process and in small part the result of mechanical obstruction by membrane or the swelling and œdema that accompany it. Often we see fatal cases of laryngeal diphtheria, in which the stenosis has required operative treatment, showing only a fine granular membrane, the lumen of the larynx still wide. How much swelling and œdema may disappear at the time of death we cannot say, but certainly membrane alone rarely obstructs the larynx. This view is strengthened by the common experience that any excitement greatly intensifies the severity of the stenosis. A child may sleep quite comfortably though breathing stridulously and with some labor; waken it and with the first frightened cry the larynx closes as though in a vise, and, unless the child be quickly quieted, operative relief will soon be required. This point is dwelt upon at such length for the purpose of enforcing its consideration in treatment. Quiet will do a great deal in controlling advancing stenosis. Vomiting will, for a time, relax the spasm, but in true diphtheria the stenosis rapidly returns. At any time the severity of the stenosis may relax, the symptoms all gradually subside, and the patient go on to make a good recovery, but, unless relieved by treatment, the cases usually end in death by suffocation. In such a case the cyanosis deepens, the respiration becomes more and more labored, the violent struggles for air cease, the patients sink into stupor, convulsions develop, and death soon follows.

Such an outcome is most common in infants, who usually succumb in from twenty-four to forty-eight hours from the onset. In other cases the course is slower; the disease reaches its height in from two to three days and terminates within a week.

Broncho-pneumonia is a common complication of laryngeal diphtheria. It may develop as the result of direct extension of the membrane from the larynx to the trachea and bronchi, or it may result from the inspiration of the inflammatory exudate containing pathogenic bacteria. The mode of its development cannot be clinically determined. Its presence is indicated by heightened temperature, more rapid respiration, greater cyanosis, usually numerous coarse or subcrepitant râles over both chests posteriorly, and more marked prostration. It makes the prognosis much more grave in any case and fre-

quently causes death when the stenosis has been relieved by operation. It was one of the late Dr. O'Dwyer's observations that, in descending diphtheria, when the membrane passed from the trachea into the median bronchi, this invasion of a new territory was marked by a rapid rise of temperature which, in turn, was soon followed by developing pneumonia.

When laryngeal diphtheria develops secondarily to diphtheria of the nose or throat, or as a complication of the infectious diseases, the symptoms above described are superadded to those of the original affection, and the patient is all the less likely to survive.

Complications and Sequelæ. — Otitis media is an occasional complication of diphtheria. It is developed by direct extension of the inflammatory process through the Eustachian tubes and belongs to cases in which the rhinopharynx is involved in the diphtheritic process.

Literature of '96 and '97.

The middle ear is very commonly affected in diphtheria; but the onset of the invasion is free from pronounced symptoms, and is mild in character throughout; it is not an extension along the Eustachian tube, but is an affection of the mucous cavities of the ear complicating diphtheria: one of the symptoms of a general infection. Lommel (Archives of Otol., Apr., '97).

In some cases the ear affection is of the severest type and there is considerable destruction of the drum-membrane. It may even result in gangrene. Pneumonia, as already noted, is the most frequent and dangerous complication. It is most common in laryngeal diphtheria, but may follow any form of the disease. It is attributed to the action of the pyogenic cocci, especially the streptococci, though Stephens and Kanthack, Wright, More, and others have demonstrated the presence of the diphtheria bacillus in the lungs.

Literature of '96 and '97.

Diphtheria bacillus is frequently found in the cervical and bronchial glands of fatal cases of diphtheria. In 26 fatal cases the diphtheria bacillus was found in the lungs in 26; in 21 cases in which the spleen was examined it was found in 10; and in 3 cases in which the kidney was investigated it was found in 2. In fatal cases there is an extensive escape of the bacillus into the lungs and other organs; the bacilli readily escape into the lungs and are usually there present in large numbers; the broncho-pneumonia complicating diphtheria is not pyococcic, but is often, if not generally, of diphtheritic nature. Kanthack and Stephens (Jour. Path. and Bact., vol. iv, No. 1, July, '96).

Specimens from three cases of hæmorrhagic diphtheria exhibited. In all cutaneous purpura and mucous-membrane hæmorrhages occurred before death, which resulted from septicæmia, and not from laryngeal or other obstruction. In each case diphtheria bacilli were found in the lungs. In the heart's blood diphtheria bacilli were found in one case, the pneumococcus in another, and in the third the Klebs-Loeffler with streptococci. Diphtheria is not always a local disease, but can always be cultivated from the lungs and frequently from other organs. Stephens and Parfitt (Lancet, Feb. 6, '97).

The affection takes the form of broncho-pneumonia and is commonly met with in the lower lobes, but may be seen in any part of the lungs. The areas are scattered and separate or may merge into one another till considerable portions of both lungs are consolidated. This complication usually develops at the height of the disease, but may occur at the very beginning, within the first twenty-four hours, or may arise during convalescence

after the throat is clear. Its onset is marked by increased temperature; disturbance of the pulse-respiration ratio, —namely, from a relation of 1 to 4 to 1 to 3; greater prostration and the signs of a diffuse bronchitis; only when considerable areas are involved do we obtain the signs of consolidation.

Pleurisy is rarely met with. Empyema may develop, especially in septic cases. Emphysema is frequently seen in laryngeal cases; it may be interstitial and may extend to the cellular tissues of the neck, but is commonly vesicular. The heart is more seriously affected in diphtheria than in any other of the acute infectious diseases, and many of the fatal cases are due to rapid or sudden heart failure. It follows tonsillar or pharyngeal diphtheria frequently, and is rare after other forms. Goodall, in a recent study of these cases, gives three types of the affection:—

1. Heart-failure while the exudate is still present in the throat and before other symptoms of paralysis present themselves. It is then due to the direct action of the diphtheria toxins upon the nerve-mechanism of the heart.

2. Heart-failure after the disappearance of membrane, but during the time of other symptoms of paralysis, when it may be due either to disturbed innervation or to fatty changes in the heart-muscle, such as are met with in other fevers.

3. Heart-failure during convalescence, some time after the disappearance of membrane; it is then probably caused by degeneration of the heart-muscle or of the pneumogastric nerve (neuritis).

Literature of '96-'97-'98.

Careful autopsies made of twenty-two cases in which death was due to some cardiac complication. In eight of these cases the vagus, stained by Marchi's method, showed evidence of degeneration. The cells in the nucleus showed no change, even when there was marked degeneration of the fibres of the nerve. The myocardium in these cases was not systematically examined, but the weight of the heart was found to be almost constantly increased. If four weeks have elapsed without any indication of cardiac trouble, there is little likelihood of its appearance at a subsequent period of convalescence. J. J. Thomas (Boston City Hosp. Med. and Surg. Reports, '98).

Whether occurring early or late in the disease, the symptoms of involvement of the heart are, in general, the same: the pulse becomes either more rapid or more often slower; it may be intermittent or irregular; in any case it is much weaker. The patients are greatly prostrated, may refuse food, and may vomit repeatedly. The surface of the face and extremities may be pale and cold, or there may be dyspnœa without cyanosis. There may be some præcordial distress. After continuing in this condition for hours or days the patients may rally, the heart gradually resumes its normal action, the symptoms disappear, and recovery ensues. More often the alarming symptoms grow worse and the patients succumb to the cardiac weakness. Death may be caused by sudden syncope induced by slight exertion or excitement. In some of the cases the patients are regarded as thoroughly convalescent and may be up and about, when sudden and unforeseen paralysis of the heart results in instant death. The cardiac affection, while most often seen after severe diphtheria, may be a sequel of the mildest cases. Hæmorrhages into the skin or from mucous membranes may be met with during the height of the disease. They are most frequent from the nose and may be so severe as to require plugging of the posterior nares. They may occur from other mucous membranes: the stomach, intes-

tines, or rarely the bladder. In the skin the hæmorrhage may give rise to petechiæ or may infiltrate considerable areas.

The petechiæ are most often seen upon the abdomen and lower extremities, but may occur upon any part of the body. They are caused by changes in either the blood or the vessels or both, and are usually seen in the severer types of toxæmia. The hæmorrhages are in some cases sufficient to seriously exhaust the patient and may even cause death.

Thrombosis and embolism are among the rarer complications of diphtheria. They may affect the extremities, giving rise to the usual symptoms: sudden pain, numbness, and coldness of the limbs, followed by paralysis, œdema, and even gangrene. Some of the cases of cardiac paralysis may be caused by thrombosis or embolism of the vessels of the heart. Affecting the cerebral arteries, thrombosis, embolism, or hæmorrhage may give rise to hemiplegia.

In very rare cases the stomach may be involved in the diphtheritic process; but, apart from such involvement, gastric symptoms are common. Persistent vomiting is a frequent and grave occurrence in severe cases. It may be due to the fever and toxæmia, or to nephritis or to heart-failure.

Diarrhœa is often met with during the height of the disease, and may persist for some time after the diphtheria itself is improved. It may be due to enterocolitis or may be dependent upon the constitutional condition, especially in the septic cases. The local lesions are not severe and have no direct relation to the diphtheritic process. As already noted, hæmorrhages may occur from either stomach or intestine in rare cases.

The kidneys are more or less affected in all severe cases of diphtheria. The lesion may be an acute degeneration, marked by more or less albumin in the urine, or acute exudative nephritis with albumin and casts, but without dropsy or uræmic symptoms. Very rarely an acute diffuse nephritis with diminished urine containing albumin and casts, or suppression of the urine, dropsy, and uræmia may be seen.

The albuminuria usually comes on during the height of the disease, continues for a time, and disappears rapidly with improvement in the local symptoms. Only in the rare cases in which acute diffuse nephritis develops are the renal complications likely to persist. Marked albuminuria is always an evidence of a grave infection, while not of itself a serious complication. It is most common in the septic cases, and belongs distinctly to pharyngeal or tonsillar diphtheria. In very rare cases there may be hæmorrhages from the kidneys.

Mention has already been made of the fact that, pathologically and experimentally, the most characteristic lesion of diphtheria is that affecting the nervous system and giving rise to paralysis of various groups of muscles. Clinically, paralysis is infrequent, but in its distribution, type, and course, none the less characteristic. In 2448 cases collected by Sanné paralysis was noted in 11 per cent.; in a series of 1000 cases reported by Lennox Browne in 14 per cent.; in 1071 cases belonging to preantitoxin days studied by Goodall, after deducting a mortality of 33.8 per cent., he says he observed paralysis in 125 of the 709 survivors,—17.6 per cent. of the latter number, or 11.7 per cent. of the whole number; in 3384 cases, treated by antitoxin, comprised in the Report of American Pediatric Society, paralysis was met with in 328 cases,—9.7 per cent. of the whole number. Of the 2934 cases that recovered, 276—or 9.4 per cent.—showed pa-

ralysis, while, of the 450 fatal cases, paralysis was observed in 52, or 11.4 per cent. Simply taking the totals of these figures without relation to the question of treatment, we have 852 cases of paralysis occurring among 7903 cases, or in 10.7 per cent.

Paralysis usually complicates the severer cases of pharyngeal diphtheria, but may be seen after milder forms, and it has even been reported as following affections of the throat so mild as to have attracted little or no attention.

The time of the onset of paralytic symptoms varies greatly in different cases. It may occur at the height of the disease in the latter days of the first week or the beginning of the second, but is usually seen some time after the throat is altogether clear during the third or fourth week of the disease, and may occur as late as the tenth week after the onset. In the cases reported by Goodall the paralysis was observed from the seventh to the forty-ninth day.

In 171 cases of diphtheritic paralysis collected by Ross the following distribution was observed: Palate affected in 128; eyes in 77, in 54 of which the muscles of accomodation suffered; lower extremities in 113; upper extremities in 60; trunk or neck in 58; muscles of respiration, 33. Of the 328 cases reported to the American Pediatric Society the distribution was specified in 187.

Of this number in 120 involved the throat (palate, pharynx, and larynx); in 14 the extremities; in 11 the eyes; in 32 the heart; in 1 the muscles of respiration; in 1 the sterno-mostoid; and in 8 the paralysis was general.

In the past year or two a number of cases have been seen in which the diphtheritic poison has affected the posterior muscles of the neck, allowing of a dropping forward of the head and an undue prominence of the cervical vertebræ. W. R. Townsend (N. Y. Med. Jour., Feb. 24, '94).

Literature of '96 and '97.

Hemiplegia following diphtheria in thirty cases collected out of medical literature, to which are added two more personally observed. In seven the lesion was probably due to hæmorrhage, in ten to embolism, but the etiology in the remainder was doubtful. Thomas (Amer. Jour. of Med. Sci., vol. iii, p. 384).

In the series published by Goodall, the palate alone was first affected in 66 per cent. of the 125 cases, and in combination with other muscles it was involved in 12 per cent. more. In a little over one-half of the cases the paralysis was limited, and in 12 per cent. it was generalized. The affection of the throat is therefore much the most common. It may occur alone or be followed by paralysis of other parts: the eye, the extremities, the trunk, or neck. In some cases it precedes the cardiac paralysis, but, as a rule, this most grave form of diphtheritic paralysis appears unannounced. Absence of the patellar reflexes is observed in most cases of diphtheritic paralysis, even when there is no loss of power or sensation in the lower extremities, and is regarded as a sign of the probable appearance of paralysis elsewhere.

In most of the throat cases the uvula and soft palate alone are involved. Nasal voice and regurgitation of fluid through the nose evidence the loss of power in these parts, and upon inspection we see the uvula hanging straight downward, relaxed, and motionless upon the back of the tongue. Sensation as well as motion is gone, and there will be no response to irritation. If the pharyngeal muscles are involved, there is difficulty in swallowing, and, if the larynx suffers,

there will be aphonia and severe coughing upon attempt at swallowing anything by reason of the entrance of food or drink into the imperfectly closed organ. The latter class of cases is very likely to prove fatal through the development of pneumonia from the inspiration of foreign material. In the extremities—arms, legs, or neck—we see more or less complete loss of power and sensation. The paralysis may not, however, be generalized in these parts, but appears at times to attack only the muscles supplied by a particular nerve-trunk, or even a branch of a main nerve. The paralysis may be so extensive as to render the patient perfectly helpless. When the trunk is involved, the gravest danger arises from implication of the muscles of respiration. Usually the diaphragm is first involved, but the intercostals may suffer. If the diaphragm is paralyzed, the respiration is entirely thoracic; if the intercostals, then the diaphragm alone must do the work. Either affection is characterized by attacks of urgent dyspnœa, with cyanosis. The wind being perfectly clear and respiration maintained only by the greatest effort on the part of the victim, the distress is often terrible. The danger of suffocation is imminent. Such an attack may pass off and there be no return; but more often they recur in a short time. The patient may remain in this condition for several days, before death finally ends the struggle.

Few of these cases recover: only eight in thirty-three of Ross's series. At any time there may be involvement of the pneumogastric nerves as well as the phrenic, the new invasion declaring itself by attacks of abdominal pain, vomiting, and feeble and slow or irregular pulse. At other times the heart may continue to act quite normally despite the respiratory distress.

We have already spoken of the purely cardiac type of this affection, for it is impossible on clinical grounds to separate from one another the cardiac failure due to changes in the myocardium from that produced by involvement of the pneumogastric or other cardiac nerves by the neuritis. Furthermore, the two conditions are often associated. It may be well again to point out the suddenness with which cardiac paralysis may occur by quoting from the Report of the American Pediatric Society the following paragraph: "Observations of some of the individual cases are interesting, particularly those of cardiac paralysis. It is twice stated that the child had gotten up and walked out of the house, where it was found dead.

"Twice death occurred after sitting up suddenly; once, on jumping from one bed to another. One patient of twenty years got up contrary to orders and died soon afterward. Another patient was apparently well, until he indulged in a large quantity of cake and candy, soon after which cardiac symptoms developed and he died shortly."

When the eyes are affected there is indistinctness of vision usually resulting in inability to read, caused by paralysis of the muscles of accommodation. The pupils may be dilated or sluggish in action from involvement of the sphincter iridis. Strabismus or ptosis from paralysis of the extrinsic muscles of the eyes are rarely seen.

Literature of '96 and '97.

One hundred and fifty cases of post-diphtheritic paralysis of accommodation observed. Paralysis set in two to three weeks after the beginning of the diphtheria in the throat, lasted about four weeks, and always disappeared sponta-

neously. The degree of paralysis was not always proportionate to the intensity of the disease, and ranged from +1 D. to +6 D. for five letters at 9 inches. All the cases except six presented an hypermetropia of 1 to 3 D. This was explained on the ground of childhood hypermetropia.

The onset is sudden, the recovery gradual. Rarely is there paralysis of the sphincter of the pupil. Moll has observed it only four times.

Accompanying paralyses were as follow: Sixteen times paralysis was double and three times unilateral of the sixth pair. Diplopia must be tested for with colored glass. Once a unilateral ptosis. Once insufficiency of the right internal rectus with asthenopia in a chlorotic subject. In the majority of the cases paralysis of the velum palati and the pharynx. The fundus was always normal. H. Coppey (Arch. d'Ophthal., No. 2, p. 117, '97).

Facial and glossal paralyses have both been reported, and in some of the severest types of general paralysis the sphincters of the bladder and rectum are said to have been involved.

If the case does not result fatally either directly from the paralysis or from the diphtheria itself or other complications, the paralysis will surely recover. In none of the cases observed by Goodall was the paralysis permanent. The time required depends upon the degree and extent of the paralysis. Those in which the throat alone is affected usually recover completely within a week or two. Cases of multiple or generalized paralysis may require three or four months to regain normal power.

Differential Diagnosis.—The bacteriological investigations inspired by the identification of the Klebs-Loeffler bacillus have greatly simplified the question of the relationship of the various pseudomembranous inflammations.

The fact of not finding diphtheria bacillus in cases of clinical diphtheria always due to some error in technique. Important practical point: On the surface of membrane bacilli frequently die; therefore, if the culture be taken directly from the surface, in majority of cases a negative result will be obtained. If the wire be passed through the membrane or along its edges a positive result is almost invariably reached. McCollom (Boston Med. and Surg. Jour., May 9, '95).

The diphtheria bacilli found most abundantly in the superficial layers of the exudation, and not, as formerly taught, in the deeper tissues. Separated from epithelium of the mucous membrane by a layer of fibrin and small round cells, in malignant cases form almost a pure culture in this situation. Thomas Cherry (Australian Med. Jour., Apr. 20, '95).

Loeffler bacillus present in much more than 73 per cent. of real clinical diphtherias. F. G. Novy (Med. News, July 13, '95).

We now know definitely that there are but two great types: the one termed pseudodiphtheria, produced by streptococci or staphylococci and belonging to the acute infectious diseases,—measles or scarlet fever,— and true diphtheria, produced by the specific bacillus, and usually a primary and independent affection.

Literature of '96 and '97.

In a clinical and bacteriological study of 142 cases of scarlatina the following conclusions were reached: 1. In 65 per cent. of all fresh cases of scarlatina diphtheritic deposits were recognized in the throat. 2. In 53 per cent. of these cases the Klebs-Loeffler bacillus could be cultivated. 3. In 38 per cent. streptococci only were found. 4. It is characteristic of scarlatina that streptococci are found in the disease with greater frequency than they are in diphtheria. 5. In streptococcic diphtheria complicating scarlatina the diphtheritic process may reach the larynx and even deeper parts. 6. When true diphtheria complicates scarlatina, the bacillus of Klebs and Loeffler replaces the streptococci pri-

marily found in the throat. Ranke (Versamml. der Gesellsch. Deutsch-Naturforscher und Aerzte, '96).

On the other hand, these investigations have added complexity to the problem of diagnosis of throat affections by showing the presence of the specific bacilli of diphtheria in many cases of sore throat free from membrane and previously passed over as simply "catarrhal" sore throat, and also in many of the cases of a fairly definite clinical type, formerly classified as follicular tonsillitis.

Clinically it is almost impossible to diagnose many throat affections from diphtheria; results of 860 cases examined bacteriologically showing this. Landouzy (La Presse Méd., Aug., 3, '95).

Literature of '96 and '97.

There are some anginæ which, although resembling diphtheria, are not caused by Loeffler's bacillus. A typical lacunar tonsillitis may appear absolutely indistinguishable from ordinary follicular tonsillitis, and sometimes the diphtheritic process may start in the lowest parts of the tonsils and so escape detection. It is well to isolate cases of lacunar angina, and during an epidemic of diphtheria they should be looked upon with much suspicion. It is better that diphtheria should be diagnosed too often than that cases of true diphtheria should be overlooked. Vierordt (Berliner klin. Woch., Feb. 22, '97).

In the shifting of the lines that has followed these revelations a considerable degree of mental confusion has been engendered and an uncertainty fostered that has led many to lose all faith in the results of clinical observations. If it is necessary to rearrange the lines of classification somewhat, it is not required that we abandon all our former conceptions or no longer trust to careful observation. In the great majority of cases thorough examination and careful consideration of all the factors concerned will enable one to reach a positive diagnosis without awaiting the results of a bacteriological examination, although the latter should always be employed if possible. For the sake of clearness we shall follow the order adopted in the description of clinical symptoms.

Nasal Cases.—The only cases that are difficult of diagnosis are those of primary nasal diphtheria. The thin, irritating, muco-purulent discharge, often brownish from the presence of blood, is quite different from the abundant, ropy mucus seen in simple catarrhal inflammation. Excoriation of the nares and eczema of the upper lip produced by the discharge are suggestive of diphtheria. Careful inspection may show the presence of more or less white or grayish-white exudate on the mucous membrane, in which case the diagnosis of diphtheria may be safely advanced. Furthermore, the diphtheritic cases are accompanied by some slight rise of temperature, anorexia, and a distinct degree of constitutional depression not seen in cases of simple inflammation. Finally, these cases are much more often seen in institutions where the children are more or less constantly exposed to diphtheritic infection than in private or dispensary practice.

Pharyngeal, or Tonsillar, Cases.—These often present difficulties in diagnosis, but a full consideration of all the factors in any case will usually lead to a correct judgment. The most difficult cases are the milder ones, where there is little or no membrane and the constitutional symptoms are slight. The question of exposure should be considered in every case. Children gathered in hospitals or asylums or attending schools are especially exposed to diphtheritic infection, and in them any form

of sore throat may justly be looked upon with suspicion. So far as the catarrhal form of diphtheria is concerned, even with a history of exposure, there is no way of making a diagnosis of diphtheria in the early stages except by bacteriological cultures. The after-course of some of these cases—in which we may see invasion of the larynx, broncho-pneumonia, nephritis, or paralysis—may show them to have been diphtheria, when no suspicion has previously been entertained.

When diphtheritic membrane is present in the throat, it usually presents certain definite characters. It begins as a thin, translucent deposit upon one or both tonsils. Gradually or rapidly it becomes thicker, and assumes a white, gray, or grayish-green, brown, or—in malignant cases—black color, and extends peripherally to cover a larger and larger area. It is firmly attached to the mucous membrane or underlying tissues and cannot be easily rubbed off. If removed by force, a raw, bleeding surface is left, and in a very short time the membrane is reproduced in its original or even a greater extent. Beginning upon the tonsils, the membrane rapidly extends to other parts: the lateral walls of the pharynx, the fauces, or uvula. Upon any of these parts the membrane presents the same characters as at the original site. This extension of the membrane is most characteristic of diphtheria. The only cases in which we are likely to see such extension of a pseudodiphtheritic membrane are the throat inflammations accompanying other infectious diseases, measles, small-pox, and—most of all—scarlet fever. The great majority of the membranous throat affections seen in the early stages of these diseases are produced by the action of streptococci or staphylococci. When a similar process is seen as a late complication of infectious diseases, it is more probably true diphtheria.

The early temperature in diphtheria is not usually high; it is, in fact, generally lower than in pseudodiphtheria, with an equal amount of membrane. A high temperature in the beginning is, therefore, an indication that the case is not diphtheria. On the other hand, the prostration is greater in diphtheria than in pseudodiphtheria. The pulse is feebler; the patients look and feel sicker than they do when suffering from pseudodiphtheria. The presence of a nasal discharge of the character described as belonging to nasal diphtheria and marked swelling and tenderness of the cervical lymph-nodes help to distinguish some cases in the early stages. Later we look for the development of the typical complications or sequelæ of diphtheria: invasion of the larynx, broncho-pneumonia, albuminuria, or some of the manifold forms of paralysis. The occurrence of any of these processes is usually sufficient to make the diagnosis certain, although it is not impossible that any of them except the paralysis may be seen in cases of pseudodiphtheria. Paralysis subsequent to throat inflammation is seen only in diphtheria. Pseudodiphtheria is, in the great majority of cases, a milder disease and of shorter course than diphtheria. As already remarked, the primary throat inflammation of scarlet fever most closely resembles true diphtheria. In fact, in every case where diphtheria is suspected, the possibility of scarlet fever must be borne in mind and examination made for the eruption. Oftentimes it will be found at the very first examination; at any rate, a brief delay will suffice to determine the question, as the eruption of scarlet fever so quickly follows the ini-

tial symptoms. It may even happen that the throat symptoms of measles may simulate diphtheria, and especially if the eruption be delayed for a number of days. Here, however, there is rarely any membrane at all, and the presence of conjunctivitis, with the simple mucous discharges from nose and throat, should be sufficient to prevent mistake. Furthermore, if Koplik's observation of the occurrence of an eruption of peculiar bluish-white specks upon a reddish background on the mucous membrane of the mouth previous to the appearance of the regular skin exanthem of measles be proved correct, it should furnish another basis for differential diagnosis.

Laryngeal Cases.—When the laryngitis appears as the extension of a previous process in nose or throat, except in the case of measles or scarlet fever, we can safely put it down as diphtheritic. The pseudomembranous throat inflammations of measles and scarlet fever often involve the larynx, trachea, and bronchi, although the processes are not diphtheritic. In any other case such extension is almost conclusive evidence that we have to do with diphtheria. The greater difficulty is prevented by the primary cases of laryngitis in children. The characteristic feature of diphtheria of the larynx is its progressive, unremitting dyspnœa with aphonia. The disease steadily advances to laryngeal stenosis and death from strangulation, unless relieved by treatment. Simple catarrhal, or non-diphtheritic, pseudomembranous laryngitis, on the other hand, usually shows frequent and decided remissions—its crises belonging to the night, the day showing decided remission of all the symptoms. As in the pharyngeal cases, early high temperature belongs rather to the pseudodiphtheria. If laryngeal examination be possible and we can see and determine the character and extent of the membrane in the larynx, we ought to be able to reach a positive diagnosis; but, unfortunately, such examination is not practicable among young children, who furnish the great majority of the cases of acute laryngitis. Of 283 cases of acute laryngitis subjected to bacteriological examination by the New York Board of Health, 229—or 80 per cent.—proved to be true diphtheria; so that in the city, at least, the diagnosis in any such case would incline to diphtheria.

Differential Diagnosis.

Diphtheria.	Pseudodiphtheria.
1. Exposure to infection from previous case of diphtheria.	1. No such exposure: arises independently.
2. Greatest liability in early years: first to fifth year.	2. Occurs at any age.
3. Membrane either seen from first upon pharynx, fauces, or uvula, as well as tonsils, or rapidly extends to these parts.	3. Membrane limited to tonsils.
4. Membrane firmly attached to underlying tissues, and not easily rubbed off.	4. Membrane loosely attached and easily removed.
5. If membrane be removed, leaves bleeding surface.	5. Membrane may be removed without such bleeding.
6. If removed, membrane is very rapidly reproduced in an even greater amount.	6. Reproduction of membrane not so rapid or extensive.
7. Discharge from nose, thin, irritating, often bloody, and produces eczema of upper lip.	7. Nasal discharge not so common, and is simple, muco-purulent.

8. Submaxillary and cervical lymph-nodes swelled and tender.	8. Swelling of lymph-nodes not so marked in primary cases; is regularly met with, however, in throat inflammations of scarlet fever, etc.
9. Membrane may be seen upon buccal mucous membrane, tongue, angles of the mouth, or lips.	9. Not seen upon these parts.
10. Onset gradual, temperature low at beginning.	10. Onset more sudden; temperature higher.
11. Constitutional depression is more marked, the pulse weaker, and children more prostrated.	11. Constitutional symptoms usually in proportion to temperature; more moderate. Pulse rapid, but not weak, and depression not so marked.
12. Course longer: usually five days to a week before marked improvement is seen.	12. Course shorter, except in cases complicating infectious diseases; is usually three or four days.
13. Albuminuria common and severe nephritis frequent.	13. Much rarer.
14. Larynx often involved by extension.	14. Larynx rarely attacked secondarily, except in measles or scarlet fever.
15. Paralysis of more or less extensive groups of muscles may occur, as a complication or sequel.	15. No such paralysis seen.

While it is true that, as many authorities maintain, in 95 per cent. of the cases which an expert after careful consideration would pronounce diphtheria, cultures will show the presence of the specific bacillus, it must be frankly admitted that there are many cases in which the most careful observation cannot determine positively the question whether a given case is true diphtheria or pseudodiphtheria. Thus, in Scientific Bulletin No. 1, of the New York Board of Health, we find it stated that "Baginsky, in Berlin, found the diphtheria bacillus in 120 out of 154 suspected cases; Martin, in Paris, in 126 out of 200; Park, in New York, in 127 out of 244; Janson, in Switzerland, 63 out of 100; and Morse, of Boston, in 239 out of 400. Thus, from 20 to 50 per cent. of the cases sent to diphtheria hospitals did not have diphtheria." If these figures approximate the truth, it is evident that we cannot trust with safety to clinical observations to determine the specific relation of cases of throat inflammation. On the other hand, the routine use of cultures from all cases of sore throat regularly shows the presence of the diphtheria bacillus in a considerable number of cases in which there were few or none of the features regarded as characteristic of diphtheria, and in which there was, therefore, little or no suspicions of the presence of the specific bacillus.

While so far as the individual case is concerned, it may be remarked that the cases in which the diagnosis is most difficult are the mild cases, those least likely to be attended with grave consequences to the patient himself, the fact should also be recognized that these mild cases are quite as dangerous to others as severe ones, and should, for the sake of the community, be subjected to strict quarantine. It is, therefore, essential to accurate work and proper care, as well as proper prophylaxis, that cultures should be made from all cases of sore throat. In no other way can we stand upon solid ground with relation to treatment, or hope to eventually gain control of the wide-spread and dangerous infection.

[Scientific Bulletin, No. 1, Health Department of the City of New York, is the

source from which the great part of the material of this section is drawn. W. P. Northrup and David Bovaird.]

Methods of Making Bacteriological Examinations. — An immediate microscopical examination of the exudate in cases of suspected diphtheria will often justify a positive diagnosis. A bit of membrane removed from the throat by a swab is smeared upon a cover-glass or slide, dried, fixed by heat, and then stained with Loeffler's methylene-blue solution.

With an oil immersion lens we may then be able to determine the presence of bacilli sufficiently characteristic to warrant a positive diagnosis. The bacilli under such conditions do not have the characteristic features which are presented by cultures upon suitable media. They are much more irregular in size, shape, and staining properties. Positive judgment is, therefore, much more difficult and uncertain. Failure to find the bacilli by this method would in no way prove that the case was not diphtheria. The uncertainties of the method are so pronounced that it is rarely employed.

The best culture-medium for routine work is the Loeffler blood-serum, coagulated by heat in test-tubes in such a way as to give an extensive slanting surface for inoculation. The swabs used in obtaining the infected material from the throat are made by wrapping a small quantity of absorbent cotton about the end of a small steel rod six inches in length. The swabs so made are inserted into test-tubes, which are then plugged with cotton and the whole sterilized by exposure to dry heat at 150° C. for one hour. To make a satisfactory culture a good view of the throat must be obtained and the swab rubbed upon the surface covered by membrane, or—in the absence of membrane—upon the inflamed parts. In laryngeal cases where no membrane is visible it usually suffices to make the application of the swab either to the tonsils or as low in the pharynx as possible. In such cases if the first culture fail to show the presence of diphtheria bacilli, it is always well to repeat the process, as a second or third culture may show the bacilli previously absent from the accessible parts of the throat. Care must be taken in inoculating the swab not to allow it to touch the tongue or any other part or surface than the one upon which the presence of the bacilli is suspected. Otherwise contaminating bacteria are inoculated upon the culture-media and the value of the culture for diagnostic purposes destroyed.

To carry out these directions in young children it is necessary that they be carefully held. The best method is to have the mother or nurse hold the child upon her right side, the child's face turned toward the light and the head resting upon her right shoulder, one of the holder's arms about the patient's legs, the other controlling the arms. The physician can then usually insert a tongue depressor and control the head with one hand, while with the other the swab can be properly directed. With very fractious children it may even be necessary to have a second assistant hold the child's head. Failure to take pains in making a proper application of the swab is accountable for many of the unsatisfactory results obtained from cultures. The swab having been properly inoculated, the cotton stopper is withdrawn from the mouth of the tube containing the solidified blood-serum and the swab then rubbed gently over the surface of the culture-medium, care being taken not to break the smooth surface of the medium. The swab is

then withdrawn, the cotton stopper, which must have been held so as to have escaped contamination from any outside source, replaced in the mouth of the culture-tube, the swab dropped into its tube again and confined by its own stopper. The culture-tubes are then ready for incubation. Koplik has described a rapid method of incubation and examination in which he allows only two or three hours' incubation at 37° C., at the end of which time he asserts that the growth of the diphtheria bacilli is more characteristic than at any other period of incubation.

Literature of '96 and '97.

There is no positive criterion by which the true diphtheria bacillus can be recognized in culture after twenty-four hours. The pseudodiphtheria bacillus is, culturally, practically indistinguishable from it, differing only in its lack of virulence. Hoffman considers the pseudodiphtheria bacillus a constant inhabitant of the mouth. Roux and Yersin found it twenty-six times in fifty-nine children of a village on the coast of France in which diphtheria was entirely absent. Bech discovered it twenty-six times in sixty-six healthy children. In view of this, what value can a method possess by which, in the required time of twenty-four hours, it is impossible to distinguish the true diphtheria bacillus from a constant inhabitant of the mouth? The length of the bacilli has been frequently regarded a characteristic feature, but very long bacilli with all the qualities of the Loeffler bacilli, except that they were non-virulent, were found in the conjunctival sac. The true diphtheria bacillus in culture, especially on white of egg, exhibits a sort of giant-growth, and presents true branching, a phenomenon also observed in the growth of the conjunctival bacillus. In view of all these facts, it is plainly not possible to distinguish the virulent from the non-virulent bacillus, and too much importance should not attach to bacteriological diagnosis without determination of virulence, especially when the diagnosis is made within twenty-four hours. Schanz (Berl. klin. Woch., Jan. 18, '97).

When there is no special reason for haste, it is usually more convenient to adopt the method followed by the New York Board of Health, of twelve hours' exposure, the cultures are kept at body-temperature over night and are ready for examination in the morning.

It is not possible to determine the presence or absence of diphtheria bacilli in the cultures upon the blood-serum from the gross appearances; but if it is found that the culture-medium has been liquefied during the incubation, it can safely be said that contaminating bacteria are present in such numbers as to render the culture valueless. The diphtheria bacilli or cocci do not liquefy the medium.

Literature of '96 and '97.

The true diphtheria bacilli do not grow in fluid antitoxic serum, nor do non-virulent pseudobacilli that render bouillon acid, while virulent organisms that render bouillon alkaline grow equally well in liquid antitoxic serum and normal serum. All forms grow excellently upon antitoxic serum that has been coagulated at 70°. De Martini (Centralb. f. Bakt., Parasit., u. Infr., Jan. 30, '97).

Upon the centre of a clean cover-glass is placed a drop of sterile water. With a sterile platinum loop a number of the colonies, which show themselves as fine, granular elevations upon the culture surface, are swept off. The loop is then immersed in the water upon the cover-glass and its contents spread evenly over the glass. The preparation after being allowed to dry in the air is fixed by passing it three times through a moderate gas-flame. It is then stained by covering it with Loeffler's alkaline methylene-blue solution and allowing it to stand for

ten minutes. The cover-glass is then washed, dried, and mounted in Canada balsam.

Literature of '96 and '97.

The following is recommended as a differential stain for the diphtheria bacillus:—

(*A*) One gramme of methylene-blue (Grubler's) is dissolved in 20 cubic centimetres of 96-per-cent. alcohol, which is then mixed with 950 cubic centimetres of distilled water and 50 cubic centimetres of glacial acetic acid.

(*B*) Two grammes of vesuvin are dissolved in 1 litre of boiling distilled water and filtered.

The cover-glass preparations are stained in *A* for 1 to 3 seconds, rinsed in water, and stained in *B* for 3 to 5 seconds, washed in water, dried, and mounted. Stained in this manner, the bacilli are brown, and contain two, or rarely three, but never more, blue corpuscles. The corpuscles are oval, not round, in shape, and their diameter appears greater than that of the bacilli in which they are situated. Neisser (Zeitschr. f. Hyg., vol. xxiv, No. 3, p. 443, '97).

The examination is made with a $^1/_{12}$ oil immersion lens. In a large proportion of the cases we see an almost-pure culture of the diphtheria bacillus; next most frequently cultures of cocci, single, double, or in chains; in some cases the cocci and bacilli are about equal in number, and in a small number only a few diphtheria bacilli are seen scattered among great numbers of cocci. From time to time we see in the cultures bacilli which closely resemble the diphtheria bacilli, but with certain definite points of distinction, and pseudodiphtheria bacilli. The diphtheria bacilli seen in such cover-glass preparations vary in length from 1.5 to 6.5 millimetres, and in diameter from 0.3 to 0.8 millimetres. They occur singly or in pairs, rarely in chains of three or four. The rods are straight or slightly curved and are not usually uniformly cylindrical throughout their length, but are swelled at the ends, or pointed at the ends and swelled in the middle. The variety in size and shape even from the same culture is characteristic. When in pairs, the bacilli may lie with their axes in the same line or forming an acute or obtuse angle; sometimes they are crossed. The bacilli show no spores, but may contain highly-refractile bodies, especially in their swelled portions. When grown upon blood-serum and stained in the manner above described, the bacilli stain in a peculiarly-characteristic way. Lack of uniformity, both in the individual bacillus and in the numbers of groups, is marked. Thus, different parts of a bacillus take the stain unequally; so that the ends are dark blue, while the centre shows little or no color, or *vice versâ*. Likewise bacilli lying side by side show marked difference in coloring, one being much more deeply stained than the other. This lack of uniformity in the staining of the bacilli seems to belong to a certain period of their growth; it is usually marked after the twelve-hour incubation, but many disappear entirely in older cultures.

Mention has already been made of bacilli found in cultures resembling the diphtheria bacillus and yet not possessing the specific pathogenic properties of that bacillus, and therefore termed pseudodiphtheria bacilli. This term is most unfortunate, since these bacilli bear no relation to the throat inflammation termed pseudodiphtheria. As seen in cover-glass preparations, these bacilli are shorter, plumper, and more uniform in size and staining. They are most often met with in cultures from the nose. When obtained in pure cultures, these bacilli have been shown to be devoid of virulence.

Literature of '96 and '97.

The methods hitherto employed to distinguish the true and false diphtheria bacillus are sufficient. The pseudobacillus is not at all the necessarily harmless microbe that has been stated. Fraenkel (Berl. klin. Woch., Dec. 13, '97).

As seen under the microscope, the uniformity in size, shape, and staining is sufficiently marked from the variations in these points noted with reference to the diphtheria bacillus to enable practiced observers to recognize them readily.

Literature of '96 and '97.

The following, which is based on the examination of 137 cases, is to show that two varieties of the diphtheria bacillus exist, and that these two varieties never pass the one into the other, even when cultivated for two years; so that they can always be readily distinguished by the microscope, if compared under the same conditions. The long form, which corresponds to the typical Klebs-Loeffler bacillus, was found in all the typical cases of diphtheria examined, and also in some cases the nature of which was not so clear. The short form, which occurred in cases of diphtheria of a mild type, was seldom met with. Its mode of growth was almost identical with the preceding variety.

Both varieties were fatal to guinea-pigs when 1 cubic centimetre of a forty hours' broth-cultivation was injected subcutaneously, but the short form readily lost its virulence and became smaller, and then somewhat resembled the pseudodiphtheria bacillus of von Hofmann. This latter organism was never met with in normal throats, but occurred in various catarrhal conditions, and frequently in cases of diphtheria, associated with typical diphtheria bacilli, though it does not follow the long Klebs-Loeffler bacillus by rote.

Its growth in gelatin-broth never showed the clear acidity characteristic of the diphtheria bacillus. Guinea-pigs, inoculated with 1 cubic centimetre of a forty hours' broth-cultivation, were never killed, nor was œdema marked in any case. The bacillus was cultivated for two years, and showed very little alteration in its morphological character.

A long non-pathogenic bacillus, closely resembling the long Klebs-Loeffler bacillus, was obtained from a case of chronic faucial catarrh. E. A. Peters (Jour. of Path. and Bact., Dec., '96).

Whenever we find the characteristic bacilli above described present in the cover-glass preparations, we can safely set the case down as one of true diphtheria, however few the bacilli may be in number in the smear, or with whatever other bacteria combined. If the diphtheria bacilli are found at all, a second culture usually shows them greatly exceeding in numbers any other form of bacteria present, and the cases will be found to present the clinical symptoms of diphtheria.

In any case, to render the bacteriological diagnosis complete, it would be necessary to obtain the diphtheria bacilli in pure culture and test their virulence by inoculation of susceptible animals.

Literature of '96 and '97.

A macroscopical and microscopical examination of the colonies developed on serum are insufficient for a certain diagnosis. Inoculation of an animal is indispensable in all cases of diphtheria, unless severe or during an epidemic. Spronck (La Sem. Méd., Sept. 20, '97).

In routine practice this is done by inoculating half-grown guinea-pigs with from $^1/_4$ to $^1/_2$ per cent. of their body-weight of a forty-eight hours' culture of the bacilli grown at 37° C. in simple nutrient or glucose alkaline broth. In carrying out such experimentation many precautions are necessary to render such work accurate and trustworthy. Much time and labor are consumed in the process. For our purposes it is sufficient to know that the great majority of those

who have carried on such experiments under proper conditions with bacilli derived from pseudomembranes and presenting the morphological and staining characters of diphtheria bacilli have found the bacilli fully virulent.

So long as the bacteriological diagnosis is reinforced by clinical evidence of the presence of false membrane and the symptoms of diphtheria, we can safely trust to the examination of these cover-glass preparations.

We find, however, that the examination of healthy throats has led to some remarkable results. In the throats of those who have been exposed to diphtheria, but have remained perfectly well, we may find characteristic and fully virulent diphtheria bacilli; in others we may find the pseudodiphtheria bacillus already spoken of, or a bacillus which, while presenting the cultural and morphological characters of the diphtheria bacillus, proved in inoculations to be non-virulent.

Thus, in a series of 330 healthy throats examined by the New York Board of Health, in 8 virulent characteristic diphtheria bacilli were found, in 24 non-virulent characteristic diphtheria bacilli, and in 27 non-virulent pseudodiphtheria bacilli. Since Hoffmann's observation of these bacilli, so closely resembling the Loeffler bacillus, but devoid of virulence, a great deal of attention has been given to this subject. Opinion is still divided as to the relation of these non-virulent bacilli. On the one hand, they are regarded simply as degenerate or attenuated forms of the diphtheria bacillus; on the other, they are represented as a distinct species.

The identity of the pseudodiphtheria bacillus seems to be now established. In form these are smaller, shorter, and thicker than the diphtheria bacillus. When seen in stained smears the bacilli are often observed to be lying parallel to one another, in contrast to the irregularly-angular disposition of the diphtheria bacillus. In their growth in broth the pseudodiphtheria bacilli develop alkali, where the Loeffler bacillus forms acid. They are never virulent. These differences are, by most authorities, considered sufficient to warrant the belief that they are a separate species.

The other class of non-virulent bacilli found in the throat present all the characters of the Loeffler bacillus except their virulence. Roux and Yersin believed these bacilli to be simply attenuated forms of the diphtheria bacillus. It was shown that they are particularly likely to be met with in the throats of those who have had diphtheria some time before, or have been exposed to diphtheria. It was also found that the diphtheria bacillus could be so attenuated by various methods of growth as to deprive it of its virulence. No one, however, has yet been able to restore virulence to any of the non-virulent forms met with, and the question must be considered as still open.

Etiology.—As early as 1879 Klebs is said to have observed the presence of a peculiar bacillus in cases of diphtheria. In 1883 his observations of the presence of this bacillus in the pseudomembranes from the throats of those dying of epidemic diphtheria were reported and brought to general attention. In 1884 Loeffler published the results of his observations. He had found the bacillus present in the great majority of cases diagnosticated as diphtheria, had been able to obtain the bacillus in pure culture, had inoculated it upon the abraded mucous membranes of susceptible animals and thereby produced pseudomembranous inflammation, often followed by

death; he had injected bouillon cultures of the bacillus subcutaneously and had found characteristic lesions after the death of the animals so treated. In 1888 d'Espine found the bacilli present in fourteen cases of typical diphtheria, and proved them to be absent in 24 cases of mild sore throat, not presenting the clinical characters of diphtheria. In the same year Roux and Yersin reported that they had found bacilli presenting the characters described by Loeffler in all cases of typical diphtheria. They showed that when inoculated upon the healthy mucous membrane of the trachea of rabbits no effect was produced; but, if the membrane were previously abraded the symptoms of pseudomembranous laryngitis in men followed. Congestion of the mucous membrane, the formation of pseudomembrane, swelling of the glands and cellular tissues of the neck, dyspnœa, stridor, and asphyxia. From that time on numerous observations were made in France, Germany, and America, until, in 1891, Welch declared that all the conditions necessary to the demonstration of the specific relation of the Klebs-Loeffler bacillus to diphtheria had been met: (1) its constant presence in cases of true diphtheria, (2) its isolation in pure culture, and (3) the production of all the symptoms of the disease by the inoculation of pure cultures in susceptible animals. Since that time evidence has been accumulated from many sources, till there can no longer be any doubt that the essential cause of diphtheria is the growth and development of this bacillus within the body. The development of the disease must, therefore, be dependent in every case upon the presence and action of the diphtheria bacillus.

The disease is common in all parts of the land. In the cities it is usually endemic, the frequence and virulence of the disease varying from year to year; in rural communities it usually occurs as distinct epidemics, each new outbreak being dependent upon the introduction of the disease from without. It may also occur sporadically. It does not, however, in any case arise *de novo*. Each new case is developed by infection, however remote, from some previous one. The infection may be either direct or indirect. Direct infection is undoubtedly most common.

The bacilli are usually present in great numbers in the discharges from the throat or nose of the patients, in the saliva, and in the membranes which may, from time to time, be coughed up. They are not, so far as evidence is had, present in the breath of the patients, but may abound in the air of the room or rooms inhabited by them. The bacilli have even been reported as present in the urine of patients.

Direct contact with the discharges from the nose or throat of those suffering from diphtheria is most dangerous. Many a physician has fallen victim to diphtheritic infection received by allowing a child to cough in his face during the process of examination. Kissing the patients may likewise be the means of infection in many cases.

> Interesting case of diphtheria of the skin observed in a child $2\frac{1}{2}$ years. On August 3d the child was scalded with hot water, the wound extending over the right side of the face, the neck, the breast, and as low as the umbilicus. On August 10th the neck was healed, and the mother kissed the child over the healed surface after the removal of the dressings. On the following day the mother developed diphtheria. The neck of the child remained free until August 13th, when there appeared on its left side, where the mother had kissed it, a swelled area of four centimetres in diam-

eter, covered with a whitish deposit and surrounded by a marked œdema, which extended up over the face. The bacteriological examination gave typical diphtheria bacilli. The child recovered after two injections of serum. Flesch (Berl. klin. Woch., No. 43, '95).

While severe cases are usually due to the action of virulent bacilli and may, therefore, be especially potent in transmitting the disease, it is not to be forgotten that apparently mild cases may harbor bacilli just as virulent and just as much to be avoided. As already remarked, the most virulent bacillus Park has met with was derived from a mild case of diphtheria. The cases of virulent pharyngeal diphtheria are most dangerous on account of the quantity of the discharge. Purely laryngeal cases have little or no discharge, and are consequently less likely to spread the infection.

The bacteria may linger in the throat for weeks after the disappearance of all clinical symptoms and the patients continue throughout the period to be sources of infection.

In 245 of 405 cases the diphtheria bacilli disappeared within three days after the complete separation of the false membrane; in 160 cases the diphtheria bacilli persisted in 103 cases for seven days; in 34 cases for twelve days; in 16 cases for fifteen days; in 4 for three weeks; and in 3 for five weeks. In many of these cases the patients were apparently well many days before the infectious agent had disappeared from the throat. N. Y. Health Board (Annual, vol. i, '95).

Indirect infection may occur by means of the clothing of the patients, the bedding, carpets, wall-paper, draperies, eating- or drinking- utensils, tongue-depressors, swabs, instruments of any kind used upon or about the patient, anything that has come in contact with the infectious discharges. Children's toys or books are especially likely to be contaminated and become means of carrying the germs to others.

In some cases persons who are themselves perfectly healthy, but who have been in contact with diphtheria cases are found to harbor the bacilli in the nose or throat and may be the source of infection to others. On several occasions the development of a series of cases of diphtheria in a single nursery of the New York Foundling Hospital has led to the examination by cultures of the throats of all children in that nursery, with the result of usually finding two or three who, while apparently healthy, had typical germs in their throats.

The isolation of these children would at once break the succession of cases of diphtheria previously observed. It may also happen that physicians or nurses transmit the germs either by their hands or clothing from one case to another. The frequent occurrence of diphtheria in the families of physicians is sufficient evidence of the need of care.

[If diphtheria is suspected or ascertained, the physician should, before entering the sick-room, remove his coat and vest, and cover his body, neck, and extremities with a blouse or a sheet fastened around his neck and body. When the physician has completed his examination, and is about leaving the family, he should bathe his head, face, beard, and hands in an antiseptic lotion, as one of corrosive sublimate or carbolic acid. All articles not required for the comfort of the patient, as the carpet, curtains, pictures, and decorations should be removed, and all persons except the physician and those who nurse the patient should be excluded from the sick-room. J. Lewis Smith and F. M. Warner, Assoc. Eds., Annual, '94.]

Apart from the question of the transmission of the disease from case to case, many other factors may influence the development and spread of diphtheria.

Sex apparently has no influence, but age materially influences the susceptibility. Nursing children are, happily, remarkably immune. The greatest susceptibility lies between the ages of two and five years; from five to ten many cases are seen; after ten the susceptibility diminishes very rapidly, and in adults it is but slight. The following table of 14,688 deaths occurring in New York in ten years, tabulated by Billington, illustrates these points:—

Under one year.....	1,214
From one to five years.....	9,622
From five to ten years.....	3,212
From ten to fifteen years...	311
Over fifteen years.....	329
Total	14,688

The season of the year exerts some influence. Thus, in England and Wales the average number of deaths for each quarter of the year, from 1870 to 1893 inclusive, was as follows: First quarter, 1000. Second quarter, 819. Third quarter, 847. Fourth quarter, 1192. (Thorne.)

Diphtheria is, therefore, more common during the cold months of fall and winter than during the spring and summer. The same fact is borne out by Bosworth's analysis of 18,688 deaths from diphtheria occurring in New York during thirteen years. Of these 10,769 occurred from October to March, and 7919 from April to September, inclusive.

The massing of children in schools, asylums, and hospitals produces conditions favorable to the development and spread of diphtheria, doubtless by increasing the chances of infection. The schools have often been pointed out as the sources of epidemics of diphtheria, which could only be controlled by closing the institutions concerned.

The following section from the Bulletin of the New York Board of Health is of interest in this connection:—

"It has been the practice of the Department to plot upon a city map the location and date of every case of diphtheria in which the diagnosis had been settled by bacteriological examination. After several months the map presented a very striking appearance. Wherever the densely settled tenements were located, there the marks were very numerous, while in the districts occupied by private residences very few cases were indicated as having occurred. It was also apparent that the cases were far less abundant, as a rule, where the tenements were in small groups than in the regions of the city where they covered larger areas. At the end of six months there were square miles in which nearly every block occupied by tenement-houses contained marks indicating the occurrence of one or more cases of diphtheria; and in some blocks many (15 to 25) had occurred.

"As the plotting went on, from time to time the map showed the infection of a new area of the city, and often the subsequent appearance of an epidemic. It was interesting to note two varieties of these local epidemics: in one the subsequent cases evidently were from neighborhood infection, while in the second variety the infection was as evidently derived from schools, since a whole school-district would suddenly become the seat of scattered cases. At times, in a certain area of the city from which several schools drew their scholars, all the cases of diphtheria would occur (as investigation showed) in families whose children attended one school, the children of the other schools being for a time exempt."

A number of epidemics have been traced to infected milk, the infection

arising from the presence of diphtheria among those engaged in handling the milk. Certain English observers have also claimed to have discovered a specific disease among milch cows, characterized by an eruption of vesicles and pustules upon the udders and teats, accompanied by the presence of the diphtheria bacillus in the local lesions, and capable of being reproduced by infections of the bacilli.

Other outbreaks of diphtheria have been attributed to bad drainage, defective sewers, or the presence of an abundance of decomposing organic matter. It is also held that certain domestic animals —pigeons, cats, etc.—are susceptible to diphtheria and may be the means of transmitting it to man.

However much or little insanitary surroundings may contribute to the development of diphtheria, the active and essential cause must be the diphtheria bacillus, and our hope of limiting the ravages of this disease must be based upon control of the individual cases, each of which is a focus for the farther spread of the infection.

The tenacity to life of the bacillus outside the body is remarkable. Hofmann found that it would live for one hundred and fifty-five days on blood-serum; Loeffler and Park for seven months; and on gelatin Klein found it living after eighteen months. On bits of dried membrane found living bacilli after fourteen weeks, Park after seventeen, and Roux and Yersin after twenty weeks. Abel says that, dried on silk threads, they may live one hundred and twenty-two days and upon a child's plaything, kept in a dark place, he found the bacilli alive after five months.

The period of incubation of diphtheria varies from two days to a week. It is doubtless affected by the number and virulence of the organisms present and by the resisting power of the patient. In most cases it is impossible to determine the time of exposure, much less that of infection. Second attacks of diphtheria are rare, but do occur. In one case observed at the New York Foundling Hospital, a boy of 4 had croup in March. The diphtheria bacilli were demonstrated in cultures from the throat. Antitoxin was given and he recovered. Twenty-five days later, having been apparently well in the meantime, he developed tonsillar diphtheria, which extended to the larynx, pneumonia developed, and death followed, thirty-four days from the conclusion of the first attack.

Pathology. — The bacteriological investigations of recent years have materially affected our views of the pathology of diphtheria. We have learned that the local lesions of the mucous membranes really constitute a very subsidiary part of the process. In them the diphtheria bacilli grow and multiply, developing in their growth certain organic substances, termed toxins, which are readily absorbed into the circulation and by their action produce constitutional symptoms and remote affects more characteristic of the disease than the local lesions themselves. The diphtheria bacilli have been found not only upon the mucous membranes, but in the lungs, liver, spleen, lymph-nodes, kidneys, and even upon the valves of the heart. They are not, however, present in great numbers in any of these organs; in fact, they are, except possibly in the case of the lungs, so few in number as to be demonstrable only by means of cultures. Their presence in the viscera does not excite characteristic lesions of these parts, and seems to be an accidental accompaniment rather than an essential part of the disease. The action of the toxins, on the

other hand, is characteristic and important. These substances have been isolated and studied especially by Brieger and Fraenkel, Roux and Yersin. They have been found to be allied to the albumins, and have been designated as toxalbumins. In experimental inoculations in susceptible animals, as shown by Welch and Flexner and others, they have been found to produce all the characteristic features of diphtheria except the membrane, especially the characteristic post-diphtheritic paralysis. The most striking of their remote effects are produced in the lymph-nodes and liver. In the lymph-nodes they produce a distinct hyperplasia; in the liver necrosis or death of small areas of liver-cells, focal necroses, similar to those seen in the liver in typhoid fever and other infectious diseases.

We must, therefore, believe that the presence of these soluble poisons in the circulation constitutes a very important feature of diphtheria. These toxins, as already noted, are elaborated in the local lesions of the mucous membranes, and not by the bacteria that may be present in the various viscera. The quantity and quality of the toxins generated seem, as a rule, to be proportionate to the severity of the local process.

Catarrhal Diphtheria. — As we have already seen, the local effects of a diphtheritic inflammation vary greatly. In catarrhal diphtheria we see simply redness and some swelling of the mucous membrane of nose, throat, tonsils, or larynx, usually with an increased secretion of the mucous glands. None of these would show macroscopically in the rare cases, when death follows such a process. Oertel has, however, found in these cases degeneration of the epithelial cells of the mucous membranes similar to those seen in pronounced cases of diphtheria.

The Diphtheritic Membrane.—The membrane is most frequently seen upon the tonsils, soft palate, uvula, pharynx, nares, larynx, trachea, or bronchi. In severe cases it may appear upon the lips, especially at the angles of the mouth, the buccal mucous membrane, and the tongue. Very rarely it appears in the œsophagus, stomach, or intestines. In fact, the freedom of the œsophagus, when the diphtheritic membrane may be seen completely covering the pharynx and tonsils and extending throughout the whole respiratory tract even to the terminal bronchi, is most remarkable. Even in the severest cases the membrane usually stops abruptly at the beginning of the œsophagus.

It is also possible to observe a true diphtheritic membrane upon abraded cutaneous surfaces; upon wounds, as in tracheotomy; or upon the conjunctiva or the genital mucous membrane. The color of the membrane may be white, gray, greenish white, yellow, or more or less black, when there has been hæmorrhage from the affected surfaces. It may be thick and elastic, so as to be stripped off in sheets, or thin and diffluent. The thicker membrane is observed upon the surfaces covered with columnar epithelium, with a definite basement-membrane, such as the nose, larynx, trachea, and bronchi. Here, too, it is but loosely attached; so that it is often thrown off in casts during life, or after death may easily be stripped off from the underlying surfaces. Upon the tonsils, pharynx, uvula, and fauces, where the epithelium is of the squamous variety and without a basement-membrane, the diphtheritic membrane is much more closely attached. Often in these situations we see, after death, no distinct

membrane, but a diffluent exudate, which may be easily washed off, leaving a distinctly-ulcerated surface beneath.

Microscopically the membrane or exudate is found to consist chiefly of fibrin, mingled with epithelial cells from the mucous membrane, pus-cells, red blood-cells, granular material, and bacteria. The superficial parts of the membrane are granular in character, while beneath we find a more or less distinct net-work of fibrin, inclosing within its meshes the cells, granular material, and bacteria. The bacteria are the diphtheria bacilli together with streptococci or staphylococci, and rarely pneumococci. The inflammatory process may be superficial or may extend irregularly into the mucous membrane, in some cases involving the submucous tissue and even the muscular coat. The bacteria may likewise penetrate deeply into the tissues, but are usually most abundant in the superficial parts of the membrane. The epithelial cells of the mucous membrane undergo degeneration, their protoplasm becoming granular, their nuclei fragmented, and the cells ultimately breaking up into granular material. The pathological process is, therefore, a coagulation-necrosis involving the mucous membrane more or less deeply.

The pseudomembrane is cast off in masses or is gradually disintegrated, with more or less destruction of the mucous membrane. The process of separation is usually attended by a more abundant cellular exudation beneath the pseudomembrane. Except in the gangrenous cases apart from the tonsil, in which there may be extensive destruction of the tissues, the integrity of the mucous membrane is completely restored, leaving no traces of the preceding disease. Gangrene is not properly a part of the diphtheritic process, but is brought about either by especially-unfavorable conditions affecting the vitality of the patient and by the invasion of unusually-virulent bacteria other than the diphtheria bacilli, probably the streptococci.

The seat and distribution of the membrane vary greatly in different cases. The point of importance with reference both to symptoms and prognosis is the involvement of the larynx. Of 1000 cases analyzed by Lennox Browne, the larynx was involved in 159, in only 4 of which number was the affection limited to the larynx. In a similar analysis of 109 cases by Holt, the larynx suffered in 46, in 10 of which the disease involved either the larynx, or the larynx with the trachea or bronchi. Holt gives no purely nasal cases in his series; 2 are given by Browne. In the great majority of cases the membrane is found upon the tonsils or the adjacent parts, the pharynx, uvula, and pillars of the fauces. Six hundred and seventy-two of Browne's 1000 cases showed such distribution.

Since extension of the membrane usually increases the severity of the case and the probability of death, the clinical records of Browne show the comparative frequency of the various forms better than tables which are largely formed from autopsy records. Laryngeal cases are also much more frequently met with in children's hospitals or asylums than in dispensary or private practice.

In cases involving the nasal cavities the process is often catarrhal, and there may be no macroscopical lesion after death. In many such cases, however, there may be membrane in the rhinopharynx, the adenoid tissue of the vault of the pharynx being a favorite seat of the disease. When membrane is developed in the nose, it is usually thick and but loosely attached; so that it may

readily be thrown off as casts of the nares.

Upon the tonsils the membrane may be found only in the crypts, resembling a follicular tonsillitis, or it may be in scattered patches, or may completely cover the surface. It is closely adherent. The tonsils are swelled and may even meet in the median line. In most cases the membrane spreads to the surrounding parts: the pharyngeal walls, the fauces, or uvula. The epiglottis is also frequently involved in these cases, even when the larynx is not affected. The membrane often extends into the rhinopharynx and thence may pass to the Eustachian tubes and the middle ear. Upon the uvula or fauces the membrane is usually thicker and more loosely attached than that upon the tonsils.

The uvula is swelled and œdematous. The epiglottis, if involved, is swelled and thickened and one or both surfaces may be covered with membrane. After death the membrane upon these parts does not show as clearly as during life, and we are apt to find a more or less marked ulceration of the parts. The epiglottis frequently shows considerable destruction of the mucous membrane. Microscopically the pathological process may extend deeply into the submucous or even the muscular coats of these parts, but the ulceration rarely extends beyond the superficial epithelium. In cases where the membrane appears upon the pharyngeal walls it will be found to stop short at the level of the cricoid cartilage, the œsophagus being perfectly normal.

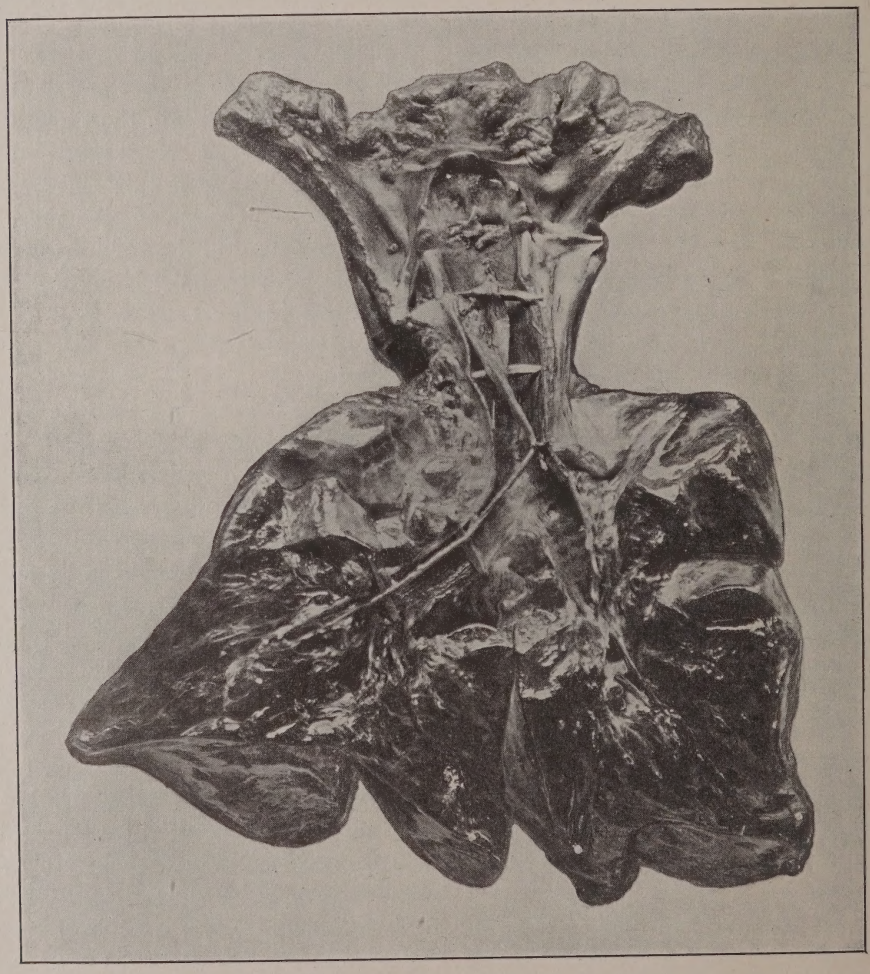
The appearances in the larynx are quite different from those met with in the throat. The laryngeal process may be simply catarrhal, even when there is abundant membrane in the throat and there have been marked laryngeal symptoms; so that the larynx after death may appear normal, or there may be a slight congestion of the mucous membrane and the vocal cords after death. In other cases we see a finely-granular deposit upon the cords and mucous membrane, and the ventricles of the larynx may be filled by a yellowish-white exudate, but there is no distinct membrane. Again we may see a distinct membrane masking the cords, obliterating the ventricles, and covering the mucous membrane below. When there is either exudate or pseudomembrane present in the larynx, it is rarely limited to that part, but will be found to extend into the trachea and bronchi, and even the lungs. In the trachea we may see scattered areas of membrane, or the membrane may line the whole extent of the respiratory tract. There is usually a much more distinct membrane in the trachea than in the larynx itself. Upon these surfaces the membrane is but loosely attached; so that it may be coughed up in complete casts of the bronchial tree, or after death may be readily lifted from the underlying tissues (see illustration).

In a series of autopsies upon 87 cases of laryngeal diphtheria made by one of us (Northrup) the distribution of the membrane was given as follows: In 9 cases the membrane extended from the tip of the nose to the finest bronchi; in 6 from the nose to the bifurcation of the trachea; in 17 from the pharynx to the finest bronchi; in 17 from the larynx to the finest bronchi; in 17 from the pharynx to the main bronchi; in 17 in the larynx and trachea; in 3 in the pharynx and larynx; and in 1 in the larynx only. This work was done in the preantitoxin days, and it must be said that in the autopsies made since the introduction of antitoxin such extensive distribution of membrane is but rarely met with.

Pseudomembrane may be found in the stomach or intestines, but is rarely, if ever, produced in these situations by the action of the diphtheria bacillus; streptococci are usually found. Occurring upon the conjunctiva, the lips, buccal mucous membrane, or the tongue, the diphtheritic membrane does not present any unusual features.

Literature of '96-'97-'98.

Case of diphtheritic stomatitis observed in a child of 4 years, who for several days had suffered with slight pseudomembranous stomatitis represented by three small patches on the end of the tongue. The condition proving rebellious to local treatment, bacteriological examination was made, and almost pure cultures of Klebs-Loeffler bacillus were obtained.



Diphtheria of tonsils, larynx, trachea, and bronchi. At upper end the tonsils and base of tongue are seen. The tonsils showed superficial ulceration, covered by thin membrane. Epiglottis is thickened. Right ventricle of larynx filled by exudate and obliterated. From left vocal cord hang some shreds of membrane. Immediately below vocal cords membrane completely covers larynx and trachea. Lifted on the skewers it contracts to a rope-like strand, which is seen extending to finest bronchi on right side. Both lower lobes of lungs consolidated by pneumonia.

Under the influence of 20 centimetres of antitoxin the case yielded in 10ur days, the pseudomembrane coming away just as in pharyngeal cases. Mongour (Treatment, Apr. 14, '98).

Upon abraded skin surfaces or upon wounds, — especially the tracheotomy wound in laryngeal cases,—the membrane may be pronounced, and is usually reproduced with remarkable rapidity after removal.

Literature of '96-'97-'98.

Case of diphtheria of the umbilicus observed in a child 14 days old. The Klebs-Loeffler bacillus was found in the pus from the umbilicus. The child gradually weakened and died within two days. Examination after death showed larynx and pharynx normal. The local lesion had not extended to other organs. Bernard Pitts (Lancet, Apr. 3, '97).

In puerperal infection in most instances the streptococcus pyogenes is found to be the morbific agent, but it is, however, not infrequent for the Klebs-Loeffler bacillus to be discovered in the discharge from the uterus; and in these cases it is probably the source of infection. Longyear (Amer. Jour. of Obst., Oct., '97).

Two cases of diphtheria in the vulva: Case I. K. McG., 2 years old. There was a history of loss of appetite; languor and high temperature, 103° to 104° F., for three days. The bacteriological and clinical examination of the throat was negative. Examination, however, showed the vulva greatly swelled, reddened, with two large patches of membrane on either labium majorum. The inguinal glands were not enlarged. A culture was taken from the membrane of the vulva, which proved positive.

Case II. L. T., 21 months. On March 2d the throat was reddened; there was a bloody discharge from the nose and some membrane, the temperature was 102° F., and the pulse 124. On March 5th a positive culture was received from the throat. Examination of the vulva showed a large patch of white membrane on the right labium majorum, extending up into the vagina. The vulva was not red or swelled as in Case I. A culture taken from the vulva on March 5th proved positive.

Diphtheria of the vulva may occur primarily, or secondarily with clinical and bacteriological diphtheria of the throat. W. P. Coues (Boston Med. and Surg. Jour., May 12, '98).

Apart from the lesions produced by the diphtheria bacilli at or by extension from the site of inoculation, they appear to produce no other direct effects, although they may be found present in the viscera. Their toxins, on the other hand, produce definite and characteristic visceral lesions. The experimental work of Welch and Flexner, Abbott, and others has served to make known these remote effects of the toxins. In the great majority of cases of human diphtheria, other bacteria, especially streptococci, are present and active besides the specific bacilli; they are mixed infections, and the problem of determining the action of any one organism is greatly complicated. In forty-two autopsies in cases of diphtheria in which the Loeffler bacillus had been demonstrated during life, Reiche is reported to have found streptococci and staphylococci in the kidney or spleen, and streptococci alone in 45.2 per cent. Streptococci were found in the kidney in one case which died on the second day, and positive results were also obtained on the third and fourth days. The results obtained by experimental inoculation of the toxins in susceptible animals are, therefore, much simpler and more easily interpreted than examinations of the viscera of fatal cases of human diphtheria. The lesions produced by the toxins are found in the lymph-nodes, liver, kidney, spleen, heart-muscle, the peripheral nerves, and lungs.

Literature of '96 and '97.

The red corpuscles of the blood in diphtheria undergo a diminution in number in cases of moderate severity and in severe cases. Regeneration is slow.

The leucocytes are increased in number in all but two classes of cases,—exceptionally-mild cases and exceptionally-severe ones. As a rule, the amount of leucocytosis is directly proportionate to the degree of severity of the case. The leucocyte-curve shows no correspondence to the clinical course of the disease. The leucocytosis is similar in character to that seen in pneumonia and scarlet fever, the increase being in the so-called polynuclear forms.

The percentage of hæmoglobin falls coincidently with the number of the red corpuscles and to the same relative degree. But the regeneration of the hæmoglobin takes place much more slowly than that of the red corpuscles.

In cases treated with antitoxin the diminution in number of the red corpuscles is much less marked than in those cases treated without it; in a majority of the cases no such diminution takes place. The leucocytes are apparently unaffected by the antitoxin. The hæmoglobin is also much less affected in the cases treated with antitoxin, thus confirming the statement as to the red corpuscles.

In healthy subjects injected with antitoxin the red corpuscles show a very moderate reduction in number in about one-half the cases. The hæmoglobin is correspondingly affected. The leucocytes are apparently unaffected by the injections.

It is improbable that any information of prognostic importance is to be gained by examination of the blood in diphtheria. J. S. Billings, Jr. (Med. Rec., Apr. 26, '96).

The blood in 24 children suffering from diphtheria examined with a view to determining the effects of antitoxic serum. In 21 cases, when examined before the injections, a manifest hyperleucocytosis was found, the degree of which varied between 1 to 71 and 1 to 275. This leucocytosis was not in relation with either the age of the child or the elevation of temperature presented at the moment of the examination; the influence of the gravity of the affection upon the leucocytosis was not constant, but, in general, the degree of hyperleucocytosis was more marked the graver the case. Hyperleucocytosis diminished as the case proceeded to recovery, but persisted in the cases terminating in death.

The influence of an injection of serum was manifested at first by a diminution of hyperleucocytosis, followed at the end of some time by an increase in the number of leucocytes, which did not always attain the degree observed before the injection. Schlesinger (Archiv f. Kinderh., B. 19, S. 378, '96).

Welch and Flexner have shown that these visceral lesions are produced either by injections of pure cultures of the diphtheria bacillus or by inoculation of their toxins.

The lymph-nodes—cervical, bronchial, mesenteric, axillary, and inguinal—are found to be swelled. There are hæmorrhages either beneath the capsule or into the substance of the glands. The cells show more or less advanced degenerative changes both in their nuclei and in the cell-protoplasm. The nuclei are fragmented; the cell-bodies are converted into a finely-granular, reticulated material, apparently fibrinous. Similar changes are observed throughout the lymph-structures of the body, Peyer's patches, solitary and agminate follicles of the intestines, etc. The changes in the lymph-nodes rarely lead to suppuration.

The spleen is swelled and usually softened. There may be hæmorrhages beneath the capsule or into the substance of the organ. The follicles are enlarged and the cells show degenerative changes similar to those seen in the lymph-nodes. The liver shows hæmorrhages either upon its surface or within its substance. There may be an advanced fatty degen-

eration of the liver. There are also found minute areas in which there has been produced a necrosis of the liver-cells, the nuclei being fragmented or having completely disappeared, while the bodies of the cells show advanced degenerative changes. Some of these areas are infiltrated by leucocytes. Similar focal necroses in the liver have been observed by other poisons than the toxins of diphtheria.

The changes in the kidney include a degeneration of the epithelium of the tubes and glomeruli and hyaline alteration of the glomerular capillaries and smaller arteries. The severe affections of the kidney, acute exudative or diffuse nephritis, met with as complications of the later stages of the disease, are attributable rather to the accompanying streptococcus infection than to the diphtheria itself.

The heart shows a fatty degeneration of its muscles, sometimes so advanced as to produce changes in every fibre. The nuclei of the muscles may also be fragmented.

The changes produced in the brain-cells of animals inoculated with diphtheria toxins have recently been made the subject of study (Carlo Ceni; Berkley). Swelling of the processes of certain cells of the brain with some minor changes in the conformation of the cells, but without evidence of degeneration of the cells or their processes, was observed. The cerebral were more affected than the cerebellar cells.

Various lesions have been found in the spinal cord in cases of diphtheritic paralysis, but none of the changes observed in the cord have thus far been accepted as the explanation of the paralysis.

Katz has recently reported finding, after careful examination of the cords of three fatal cases, distinct changes in the motor ganglion cells of the anterior horns of the cord. The changes were either a fatty degeneration affecting the cells or complete death of the cells with all processes, and especially the axis-cylinder. All ganglion cells of the cord were similarly affected, but not so markedly as the motor cells of the anterior horns.

The changes in the peripheral nerves, on the other hand, are looked upon by some as the most characteristic pathological lesion of diphtheria. The affected nerves are sometimes red and swelled, from congestion and œdema, but the degeneration of the nerve-fibres is the characteristic feature of the process. Single nerve-fibres or a whole nerve-trunk may be affected. The changes may be either interstitial or parenchymatous. In the parenchymatous form there is usually a more or less marked infiltration of leucocytes within the nerve-sheath, between the sheath and the nerve-fibres, or between the fibres themselves. The medullary sheath of the nerve-fibre is swelled, undergoes a fatty degeneration, and may altogether disappear. The axis-cylinder undergoes a similar degeneration; it may be changed to a granular mass and be completely absorbed. The empty sheaths of Schwann may be the only evidence left of the former nerve-fibre. Sooner or later the degeneration stops; regeneration begins and usually results in complete restoration of the nerve-fibres. In the interstitial form the increase of the connective tissue of the endoneurium and perineurium is the marked feature of the process. In some cases the changes are both parenchymatous and interstitial.

Literature of '96-'97-'98.

In patients dying of diphtheria we cannot always recognize appreciable morphological changes in the nervous

elements, especially if death has taken place early. Experimentally in rabbits subjected to inoculations with diphtheritic bacilli or to injection with diphtheria toxin, death is constantly accompanied by marked morphological alteration in the nervous elements. The intensity of the alteration depends not so much upon the amount as the duration of the toxic action. In patients the general rule is that these changes are limited to the protoplasmic prolongations, leaving unaltered the cell-body and the nervous prolongations. Only in rare cases, through prolonged action of the diphtheritic toxin, the atrophic process of the nervous elements presents itself in a more advanced state, indicating alterations in form, both of the cell-body and nervous prolongations. In patients dying of diphtheria the incipient atrophic process of the nervous elements is limited to a few isolated cells disseminated through the encephalic mass. Carlo Ceni (La Riforma Medica, Nos. 29, p. 338; 30, p. 351; 31, p. 363; '96).

Changes in the peripheral nerves are usually of the parenchymatous type, consisting of a degenerative process due to the presence of toxic products arising in the course of the disease, directly or indirectly from the micro-organisms producing the disease. These peripheral nerves undoubtedly show also, at times, that an interstitial process has been added to the degenerative one. J. J. Thomas (Boston Med. and Surg. Jour., Jan. 27, '98).

Four cases observed in which the diphtheria bacillus was found in the blood and in the nervous centres. In one case the germs had entirely disappeared from the throat, but were found in pure culture in the bulbar centres. Paralysis was absent. Richardière (La Rev. Méd.; Pediatrics, May 1, '98).

The pulmonary changes produced by the experimental action of diphtheria bacilli or their toxins are slight and of no importance, but the pulmonary complications of clinical diphtheria are frequent, severe, and of great moment. Wright, More, Kanthack, Stephens, and others have demonstrated the presence of diphtheria bacilli in the lungs in fatal cases of diphtheria, but the presence of the bacilli apparently has but little to do with the production of pulmonary complications. In 1889, in an investigation of a series of seventeen cases of pneumonia complicating diphtheria, Prudden and Northrup found streptococci both in the pseudomembranes in the throat and in the lungs. It was further shown that the inoculation of streptococci in susceptible animals served to produce changes in the lungs similar to those seen in clinical diphtheria. These observations have been fully corroborated, and the streptococci are accepted as the active agents in the production of the pneumonia which so frequently complicates diphtheria. Broncho-pneumonia is met with in the great majority of fatal cases, especially in hospital practice. In the most acute cases we find the posterior parts of one or both lungs deeply congested, firm to the touch, and on section showing scattered areas of peribronchial consolidation, deep red in color. The lower lobes are usually more affected than the upper. In the slower cases we find the areas of pneumonia scattered throughout both lungs, but affecting the lower and posterior portions especially, the consolidation often involving a large part of both lungs and on section appearing mottled, reddish-brown and yellowish-white. Pleurisy and empyema are rarely met with. In laryngeal cases with marked stenosis there is usually emphysema, both vesicular and interstitial. The interstitial emphysema may involve the cellular tissues of the neck and even extend over the trunk.

Prognosis. — In no other acute infectious disease is the prognosis so uncer-

tain as in diphtheria. Many factors must be taken into consideration in determining the prognosis in any given case.

1. Age of the patient. Happily children under six months of age are rarely attacked; but between that age and two years many cases are seen, and the mortality is often frightful. With increase in age the mortality falls steadily, but even in adult life diphtheria may readily prove fatal.

The following tables taken from the article of Biggs and Guerard in "The Use of Antitoxic Serum," show the favorable influence of age very clearly:—

Herz: Mortality Percentage.

0-1 year	80.00
1-3 years	45.00
3-5 years	40.00
5-10 years	17.00
Over 10 years	17.00

Hirsch: Mortality Percentage.

0-1 year	88.3
1-3 years	82.5
3-4 years	63.9
4-5 years	46.9
6-7 years	43.2
Over 7 years	22.2

Baginsky: Mortality Percentage.

0-2 years	63.3
2-4 years	52.8
4-6 years	37.9
6-10 years	24.6
10-15 years	14.6

The ratios are all derived from cases treated previous to the introduction of antitoxin or without its use. The analysis of a large number of cases treated by antitoxin, while the mortality-ratios are diminished, shows that the age influence remains practically the same.

Age.	Cases.	Deaths.	Mortality Percentage.
0-2 years	1494	469	31.4
2-5 years	3678	762	20.7
5-10 years	3184	473	14.8
Over 10 years	1444	99	6.9

Literature of '96 and '97.

Results of the serum-treatment in 7273 cases of diphtheria, treated and reported by thirty-seven medical men during the epidemic of 1896 in the Penza Government, Russia. Of these 7273 (3720 males and 3553 females) 856, or 11.77 per cent., died; 415 of the fatal cases—or 10.80 per cent.—being males, and 441—or 12.41 per cent.—females. As regards age, of 931 children under 2 years, 198, or 21.27 per cent., died; of 1847 between 2 and 5 years, 299, or 16.19 per cent. died; of 2405 patients between 5 and 10 years, 274, or 11.39 per cent., died, and of 2069 patients above 10 years 82, or 3.98 per cent., died. In 6312 cases the injections were made once, in 858 cases twice, and in 71 cases three times and more. Gavrilof (Vratch, Nos. 27, 28, '97).

2. The site of the disease. Involvement of the larynx either primarily or secondarily adds greatly to the danger of the case. The large death-rate under two years is due, in great part, to the strong tendency of the disease to invade the larynx during that period.

The use of antitoxin has materially changed all the figures relating to the fatality of the various forms of diphtheria, but the laryngeal process remains the most deadly.

3. The time of beginning treatment. In the use of antitoxin it has been demonstrated beyond the shadow of a doubt that, the earlier the remedy is employed, the surer is recovery, while after the fifth day the remedy exerts little or no influence. It has always been clear that delay in undertaking treatment led to unfavorable results, but the vital necessity of promptness has been impressed upon us by the overpowering evidence afforded by the results obtained when antitoxin is resorted to early in the case.

4. The degree of toxæmia. This feature is usually developed in proportion

to the lapse of time from, and the severity of, the onset of the disease. It may be slowly or rapidly developed, and in many cases apparently mild in the beginning we may later see the severest types of toxæmia.

5. The extent of the membrane and the rapidity of the extension.

6. The presence of complications, especially from broncho-pneumonia or nephritis. The pneumonia of diphtheria is by far the most important of the complications.

The late onset of the cardiac complications of diphtheria is to be remembered. No case of severe diphtheria can be considered altogether out of danger for some weeks after apparent recovery.

7. The surroundings of the patient. The mortality of diphtheria is considerably greater in hospitals or asylums for children than in private or dispensary practice. The crowding of the children together seems to exert a very unfavorable influence by exposing them to danger from complications, and most especially to pneumonia.

8. The mortality of diphtheria may vary greatly from year to year in the same place or in different epidemics, the causes of the variation not being apparent. Such variations in the type of the disease may properly be taken into account in the prognosis of individual cases.

Prophylaxis. — In typical diphtheria we have to deal with an acute infectious disease, in which we now know the nature of the contagion and its ways of spreading. The bacilli present in the nose or throat of the patients are the active agents, and anything which may either directly or indirectly be contaminated by the discharge from the affected surfaces may be the means of communicating the disease to others. The first step in prevention is, therefore, the isolation of the diphtheria patient. Suspected cases should be isolated as thoroughly and promptly as those in which the diagnosis is settled. It is to be remembered that during epidemics or in any case of exposure many of the mild cases of "sore throat" are, in reality, diphtheria, and should be treated as such in this respect.

Moreover, as has previously been noted, diphtheria bacilli may be found in the throats of those who, although perfectly healthy, have been exposed to infection. This is especially true of children, and in families where diphtheria is present the well children should be kept from attendance at schools or like gatherings where they may possibly convey the disease to others more susceptible than themselves. In the course of epidemics it is often necessary to close all schools before the ravages of the disease can be controlled. The past year has been marked by the establishment in our large cities of a system of inspection by trained physicians of all school-children who present the first symptoms of illness: a progressive step in preventive medicine that will undoubtedly do much to protect these communities from epidemics of diphtheria. Suspected cases of diphtheria are to be isolated, but should not be put into diphtheria wards or hospitals until the diagnosis is assured. Our reliance must be upon the bacteriological diagnosis, for in case of exposure the mildness of the individual case is no surety that it is not dangerous to others.

These cases call for especial care, both in making and in examining the cultures. With proper methods, twenty-four hours should suffice to settle the question of diagnosis. In case of doubt the isolation of the patient should be continued and the bacteriological examination repeated.

In all our large cities provision is now

made for the treatment of diphtheria in special public hospitals. To these hospitals are sent all cases that cannot be properly cared for and isolated at home. New York has recently added to her equipment a private hospital for the treatment of contagious diseases, including diphtheria. Here patients who are able to pay for their care are received as private patients. The institution is thoroughly equipped and ought to materially aid in the proper isolation of contagious cases among the classes of people whose aversion to the public hospitals has often led them to disregard the instruction and even the edicts of the health officers.

Proper isolation of diphtheria cases developing in hospitals or asylums, especially those for children, is of very great importance, since these institutions contain the most susceptible material for the action of diphtheria bacilli. They should be provided with diphtheria wards, located, if possible, in separate buildings. The isolation of such wards should be complete. In no other way can the inmates of such institutions be protected from repeated outbreaks of diphtheria.

In private houses one or more rooms should be set apart for the use of a diphtheria patient. No one but the patient and the attendants should be allowed to enter the sick-room. All expectoration, bits of membrane, etc., should be received in cups containing a solution of carbolic acid, 1 to 40, or bichloride of mercury, 1 to 1000. Instead of handkerchiefs, bits of gauze or old linen should be used, and burned when soiled. All bedding and clothing used during the attack should be soaked for several hours in a 1 to 40 solution of carbolic acid and afterward boiled. All eating utensils should be sterilized by boiling. Nothing that has been in the room should be taken from it without subjecting it to sterilization in some way.

The physician in charge of a case of diphtheria before entering the sick-room should cover his clothing by a cotton or rubber gown reaching to the feet. The gown should be kept outside the sick-room and should be sterilized at the conclusion of the case. The physician should remember that, in examining the throat in cases of diphtheria, he stands in great danger of infection by having the patient cough in his face. Many a life has been sacrificed by careless exposure in this way. As a measure of protection, the physician is often advised to have a pane of ordinary window-glass held before the patient's face during inspection of the throat. Few men willingly adopt a cumbersome device which at the same time interferes with the examination; but, in case the patient does cough during the examination, the physician should protect himself by thoroughly washing the face and hair with soap and water, and then using a solution of bichloride, 1 to 1000. The hands should always be washed and disinfected on leaving the patient's room.

Nurses caring for diphtheria patients should especially avoid contracting the disease by exposing themselves to the discharges from the nose or throat of the patient. Practically there is no danger from the breath of the patient. The nurse should keep her hands thoroughly clean at all times and should have a disinfecting solution of carbolic or bichloride at hand so that she may use it constantly. A cleansing gargle of normal salt solution, Dobell's solution, or Seiler's solution should be used several times a day. Many advise the administration of an immunizing dose of antitoxin (300 to 400 units) at the beginning.

If this is not done at that time, antitoxin in protective dose should be given at the first sign of a "sore throat."

Literature of '96 and '97.

One hundred and twenty-eight children suffering from various forms of sore throat injected with 5 drachms of serum, without slightest unfavorable result. Roux (Annual, '96).

After leaving a diphtheria case the nurse should thoroughly disinfect both her clothing and her person. It is also customary to require the nurse to allow a period of at least five days to pass after leaving a case of diphtheria before assuming charge of any other patient.

Length of Quarantine.—The bacteriological researches of recent years have given us some very definite information bearing on this point. It has already been noted that the bacilli may persist in the throat for weeks after an attack, and that such bacilli have been proved fully virulent. Park reports a series of careful observations upon the time of the disappearance of the bacilli from the throat in 1736 cases of diphtheria. Briefly, he found that the bacilli had disappeared within 1 week in 3 per cent. of the cases, in $^1/_3$ of the cases at the end of the second week, in $^2/_3$ at the end of the third week, in $^4/_5$ at the end of the fourth week, and in the remainder the bacilli persisted for varying periods up to 91 days. This last case was one of simple nasal discharge containing diphtheria bacilli, from which both nurse and mother contracted diphtheria. The mildness or severity of the case gives no basis for determining the time that the bacilli may remain in the throat. The only accurate method of determining the period of quarantine is that of making cultures from the throats. Only when cultures fail to show the presence of the bacilli in the throat or nose can the case be regarded entirely devoid of danger to others. If cultures cannot be employed, we may elect an arbitrary period of three weeks from the disappearance of membrane for the removal of quarantine restrictions. After that time, if the bacilli have not actually disappeared from the throat, they are but few in number and the danger of communication is slight.

Disinfection of the infected rooms upon the termination of the case should be thorough. The walls and ceilings are to be scrubbed with bichloride, 1 to 1000, or rubbed down carefully with bread: a simple method of removing the clinging dirt and bacteria by mechanical means. The wood-work, floor, and furniture are to be scrubbed with bichloride. The wood-work, walls, etc., are to be repainted or papered anew. Carpets, upholstery, etc., can be disinfected by steam. Clothing, linen, etc., may be boiled. Anything which cannot be disinfected by some of these means should be burned. Books and toys that children have used during their illness should be thus destroyed. Even the most careful disinfection will in some cases prove ineffective.

Apart from these measures with respect to the cases already developed, much may be done to prevent the spread of diphtheria by properly caring for children who may be exposed to infection. Catarrhal conditions of the nose and throat undoubtedly afford a favorable soil for the location and growth of diphtheria bacilli. Enlarged tonsils and adenoid growths in the naso-pharynx fall in the same category. All such conditions should be carefully treated.

Since 1893 over one hundred tonsils removed in one institution; although diphtheria has been prevalent in its

most virulent type every winter and spring in the neighboring country, no evidence of disease since, although same institution repeatedly infected before. Foster Godfrey (Ther. Gaz., June 15, '95).

Healthy mucous membranes are a safeguard against attacks of diphtheria.

IMMUNIZATION BY INJECTIONS OF ANTITOXIN.—By the injection of small doses of antitoxin it has been found possible to induce an artificial immunity which holds good for a period of at least four weeks, as a rule. Epidemics of diphtheria in children's hospitals or asylums have been repeatedly checked by protective injections of antitoxin in all the children exposed.

Literature of '96-'97-'98.

The value of immunizing injections in hospitals upon 254 children of ages varying from 2 months to 14 years observed, these observations covering a period of twenty-one months. The strength of serums varied from 100 to 3000 units, and the dose from 1 to 10 cubic centimetres. In the beginning, when the injections were made only upon patients in beds near to those which had been occupied by the diphtheritic patients, 4 cases of infection occurred. When, however, the injections were made upon all the patients of the ward, and, later, upon all patients subsequently admitted, the disease did not reappear, except in 3 cases thirty to forty days after injection, twice in children readmitted to the hospital, and once with a child that had been discharged well and returned at the end of a month with an attack of the disease. Two children admitted, but not injected on account of the gravity of their condition (pleurisy, articular rheumatism), contracted diphtheria and 1 of them died. On account of the 3 cases of infection developing one month after prophylactic injection, the injections were repeated monthly upon children who remained for any length of time in the hospital. After this plan was adopted no new case of diphtheria developed in the ward. Another series of immunizing injections was made in the measles ward upon 99 children. Of this number there were 21 cases that died, all of them under 1 year of age; but in no case was there diphtheria or croup.

In the scarlatina pavilion, where, in the interval of twenty-one months, 11 cases out of 240 contracted diphtheria, the same results as in the ward were noticed. Of 97 children who received immunizing injections, only 1 contracted diphtheria, twenty-one days after the last injection. In no case were there grave complications, and such as occurred seemed to have no dependence upon the small or large quantity of serum used. Lohr (Jahrbuch f. Kinderh., B. 43, S. 67).

Untoward effects may be avoided by injecting very small quantities for prophylactic purposes and by using only serum known to be in the best possible condition. Behring (Annual, '96).

Immunization not advantageous in a disease which can be so easily cured by the serum. Variot (Annual, '96).

Finding it impossible to stamp out diphtheria in a foundling hospital, it was determined to inoculate all the infants with Paltauf's diphtheritic antitoxin as a prophylactic against the disease. Each child was accordingly inoculated with 100 units of the antitoxin, with the result that, out of 1450 children so treated, only 2 developed diphtheria, and in 1 of those cases the onset of the disease dated seven weeks after the inoculation. In the two years previous to the adoption of this treatment no less than 31 cases of diphtheria had occurred, while in the second year of its adoption not a single case of diphtheria was recorded. The ages of the children varied from a few hours to several months.

One hundred units of antitoxin can safely be injected into even the youngest infant, and it is sufficient to give the child immunity for five or six weeks. Riether (Wien. klin. Woch., No. 28, '97).

In the Children's Hospital of Boston, of 1808 patients immunized at least once

every twenty-eight days, the amount of serum varying from 150 to 500 units, 7 had diphtheria, 3 from insufficient dosing, 2 within twenty-four hours of the injection, and 2 in whom the time of infection came twenty-three and twenty-two days, respectively, after giving an amount which had previously been effective when given every three weeks. Of 829 who were not given antitoxin, or in whom more than twenty-eight days elapsed after the injections, 9 had diphtheria, besides 3 immunized adults. Immunity in any given case, of no matter how thorough exposure to diphtheria, may be conferred for at least ten days by the injection of a small dose (100 to 250 units) of serum, provided it is given twenty-four hours previous to actual infection. A larger dose (250 units for a child of two, up to 500 units for one of eight or over) will confer safety for three weeks under similar conditions. Morrill (Boston Med. and Surg. Jour., Mar. 3, '98).

As Heubner has, for some time, made it a practice to immunize all the children in his wards at the Charité every three weeks, it may be seen what a prominent place immunization has taken here during this last year. For awhile Heubner had to give up his immunizing injections because the hospital directorate thought it savored too much of experimental investigation on the children, and might arouse popular indignation. They were resumed after an interval of only two months, however, as it had become clear that they were wonderfully efficient in preventing diphtheria in the wards of the hospital. Absolutely no inconveniences have resulted from the practice. Editorials (Med. News; Jour. Amer. Med. Assoc., May 7, '98).

In the article on the "Use of Antitoxin" by Biggs and Guerard previously quoted, a summary of thirty-five reports covering 17,516 injections of antitoxin for the purpose of immunization is given. Following these injections, 131 cases of diphtheria developed, 109 mild cases and 1 fatal case within thirty days of the date of injection; 20 mild cases and 1 fatal after thirty days. The writers state that "the duration of immunity after injection has not been definitely determined and undoubtedly varies. Some hold the opinion that it lasts only one or two weeks, others that it extends over thirty days or more. Four weeks may probably be considered as the average duration." The results certainly justify the further trial of this method of protection.

General Measures.—First of all, the sick-room should be well lighted and ventilated. Care in this respect is especially necessary in children's hospitals. Crowding a number of cases of diphtheria together in one ward is undoubtedly harmful. It is much better to have a number of small wards, accommodating three or four patients, than one large one in which all are assembled together. Cases in which pneumonia has developed should not be kept in the room with those still free from it. Attention should be given to feeding the patients, as the best means of enabling them to bear the attack of the disease upon the vital powers. Usually, on account of the soreness of the throat, fluid foods can be best taken, but semisolids can be given in some cases. Our chief reliance must be upon milk. It should be given at regular intervals, every two hours, and in such quantity as the patient will take. There is little danger of overfeeding. The difficulty is usually to get the children to take sufficient nourishment. In addition to the milk, we may give beef-juice, beef-tea, or thin gruels. In children that have been intubated, semisolids can sometimes be taken better than fluid nourishment. Bread and milk answer the purpose in such cases.

Nursing children should be fed with milk drawn by a breast-pump. In this way the children are saved the exertion

of suckling and the mothers are protected from the danger of infection.

In septic cases the children often refuse food altogether or vomit it immediately it is taken. They may then be fed by the stomach-tube. If the tube cannot be passed through the mouth, we can usually succeed in passing it through the nose. This method may also be employed in intubated cases where the attempt to swallow food is followed by violent coughing or choking.

Rectal feeding with peptonized milk is a last resort, and seems to be of little value in children.

Rest in bed is an essential feature of proper treatment. Whatever handling or interference is required should be so arranged as to tax the patient as little as possible. Zeal for thorough local treatment has often led to fatal excitement and exertion on the part of the patient. Especially in cases of cardiac weakness should absolute quiet be enjoined, and all treatment that tends to excite the child or cause it to struggle avoided. Opium or morphine may be used to insure quiet under these circumstances.

Steam inhalations have long been employed for the purpose of increasing the secretions of mucus from the mucous membranes, softening the diphtheritic deposits, and hastening their separation. The croup-kettle has almost become a household utensil. To increase the efficacy of the steam, carbolic acid, turpentine, eucalyptol and other aromatic antiseptics have been added to the boiling water. These measures are of doubtful value at any time, and when they are employed under a close canopy at the sacrifice of fresh air, as is usually the case, may be positively harmful. The testimony of adults is that, at least, the steam is very comforting.

> Convalescents should use disinfectant gargles for a considerable period. Good results are obtained by the constant employment of a disinfectant vapor, as eucalyptus, turpentine, carbolic acid, creasote, or tar. Either of these agents is added to water in a convenient vessel, and is constantly simmering by a moderate heat underneath. Mildly detergent and antiseptic gargles, such as diluted carbolic acid, boric acid and water, thymol, menthol, wintergreen, or bichloride of mercury (1 to 10,000) should be frequently employed by all persons exposed to diphtheria, as the nurse, physician, and the patient himself. Beverly Robinson (N. Y. Med. Jour., Aug. 5, '94).

Local Treatment. — The local treatment in diphtheria is of importance.

The object sought in such treatment has changed considerably within recent years. We no longer seek to remove the membrane by local applications or by mechanical means, nor do we expect to destroy the bacilli in the throat. Experience has taught us that we can get rid neither of membrane nor of bacteria by local treatment, and also that too energetic efforts to accomplish these ends do harm instead of good. We have, therefore, abandoned the mechanical removal of the membrane, the application of destructive powders or solutions to it, and the use of strong antiseptics to the affected parts. We endeavor simply to keep the nose, mouth, and throat clear of the secretions which may either obstruct them or by their decomposition and absorption increase the toxæmia.

To this end we employ bland fluids, such as normal salt solution, or a saturated boric-acid solution. The method of using the solution must be varied to suit each particular case. The most efficacious is undoubtedly the fountain-syringe. To employ this, we need only the douche-bag fitted with a smooth glass

nozzle adapted to the size of the nares. The child is wrapped in a blanket so that the arms and legs are controlled. It is then laid upon its side on a table beneath the douche, the nozzle inserted on one side the nose, and the fluid, which should be lukewarm, allowed to flow freely for a moment. As it escapes from the mouth or the other nostril, it usually carries with it considerable quantities of mucus, or muco-pus, and possibly bits of membrane. The injection is repeated till the escaping fluid is clear. Sprays are ineffective, and should not be used.

This treatment should be employed every two or three hours during the height of the disease, less often as the amount of secretion lessens, but it should not be given up until the bacteria have disappeared from the throat.

Instead of this apparatus, we may employ a simple nasal syringe. The best form in our judgment is the "bulb nasal syringe with hard-rubber pipe" made by Whitehall, Tatum & Co., of New York. It consists of a simple rubber bulb, resembling that of a Davidson syringe, fitted with a blunt hard-rubber tip adapted to the nose. Being emptied by compression, it is much more easily handled than piston-syringes. With one or the other of these apparatuses, nose and throat can be washed in practically all cases. The greatest care should be taken not to injure the mucous membrane in this treatment. Every abrasion affords a new site for the action of the diphtheria bacilli.

Severe nasal hæmorrhage may be a contra-indication to the continuance of this measure. Cardiac weakness may also forbid it, if the child struggles against it. A well-trained and skillful nurse should be able to carry out this treatment with very little tax upon the strength of the patient. In some cases, however skillfully it is done, the children fight against it so fiercely as to render its continuance inadvisable.

> In diphtheria cases which have been subjected to frequent irrigation with antiseptic solutions from the beginning of the disease, the bacilli disappear far more rapidly than in those in which such irrigations have not been employed. Occasionally, when culture-tubes are inoculated immediately after irrigation of the throat with antiseptic solutions the cultures do not show any Loeffler bacilli, although subsequent examinations may demonstrate their presence. N. Y. Health Board (Annual, '95).
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> In one series of cases irrigation with warm salt solutions every one to three hours was employed; in a second series same treatment plus spray every three hours of pyrozone, from 5- to 25-per-cent. solution; in a third series irrigation by 1 to 3000 or 4000 solution of bichloride of mercury. Warm salt-water irrigation best to remove membranes, but bacilli disappear most rapidly under corrosive sublimate, or, what is equally good, a solution of boric acid, a tablespoonful to a pint of water; latter solution used without salt water. Berg (Med. Rec., Jan. 12, '95).

Where there is much swelling of the cervical lymph-nodes, hot or cold applications may be used. Heat is preferable in infants; in older children the ice-cap may be used. Flannel pads or spongiopylin wrung out of hot water, or poultices, may be used in the former case.

General Treatment. — With the advent of antitoxin most of the remedies for diphtheria have passed from use. A few still occupy a position which warrants some attention. In the treatment of pharyngeal or tonsillar diphtheria the tincture of the chloride of iron has long been regarded as of great value. Jacobi commends its use, advising a daily allowance of 1 drachm for a child 1 year old, 2 or 3 drachms for children from 3 to 5

years old. It is to be given diluted with water and glycerin. He admits that it cannot be tolerated by some patients and that alcohol is to be preferred in septic cases. Under present conditions its use must, therefore, be very limited.

In the treatment of laryngeal diphtheria the best results previous to the use of antitoxin were attained by the administration of mercury. The drug was given internally in the form of the bichloride, or the patient was treated by calomel fumigations. The bichloride was given in hourly doses to the amount of $^1/_6$ to $^1/_2$ grain in twenty-four hours, each dose being preceded and followed by copious draughts of water. This treatment was continued for from four to eight days, and good results were claimed for it.

Calomel fumigation was a more elaborate process. A tent or canopy was rigged over the patient's crib. Beneath this tent 15 grains of calomel were volatilized every two hours for two days and nights, then every three hours for the third day, every four hours for the fourth day, and thereafter three times a day according to indications. The patients sometimes suffered from stomatitis and diarrhœa and developed pronounced anæmia; not infrequently the attendants were salivated; but this form of treatment gave better results in intubated cases than any other employed before the introduction of antitoxin.

Among other remedies that have been recommended, pilocarpine, guaiacol, citric acid, sodium hyposulphite, and myrrh have received the greatest attention; but the fact must be borne in mind that, in the majority of cases treated, the diagnosis has not been established by bacteriological examination.

Pilocarpine a precious auxiliary; less dangerous for children than for adults. Degle (Wiener med. Presse, Dec. 9, 16, '94).

Pilocarpine a specific in diphtheria. C. F. Howe (Med. Brief, Aug., '95).

In severe cases of diphtheria a beginning may be made by injecting a quarter of a syringeful of a 2-per-cent. solution of pilocarpine, and then, to keep up the action of the drug, it may be given by the mouth. If there is no improvement at the end of twenty-four hours, another injection is given. M. S. Barsky (Wratsch, Nos. 45, 48, '95).

Literature of '96-'97-'98.

Guaiacol used early seems to destroy the bacilli and prevent the spread of the pseudomembrane. Bacteriological examination of cultures taken from the same throat before and after its application has shown in the first instance the bacilli, and in the second none have been found. The formula is guaiacol, 10; menthol, 1; sterilized olive-oil, 10. The same application is of service as a prophylactic against diphtheria by application to the throat of the healthy inmates of the house in which the disease has appeared. This has been proved in two epidemics. In folliculous tonsillitis it is capable of cutting short the disease if early and thoroughly applied, and even in parenchymatous tonsillitis mitigates considerably the severity of the affection. S. Solis-Cohen (Phila. Polyclinic, No. 16, p. 157, '96).

One hundred and fourteen cases of diphtheria treated with a 10-per-cent. solution of citric acid given by the mouth. Eleven deaths occurred: a mortality of 9.6 per cent. Fifty-six of the cases were mild, 27 were of very doubtful prognosis, and 31 were decidedly grave. Four of the deaths were due to sepsis, 1 patient died after tracheotomy, and 1 died of paralysis of the heart during convalescence. Of the 11 who died, as many as 5 were not brought to the hospital until the disease had been running for from four to seven days. According to the patient's age a teaspoonful to a tablespoonful of the solution was given every two hours.

In the beginning and in severe cases, smaller doses are given, but more frequently, as often as every half-hour day and night. Bloch (Ugeskrift for Läger; Deutsche med.-Zeit., Aug. 10, '96).

A solution of sodium hyposulphite as a local application in diphtheria gives good results, three or four applications generally being sufficient to clear away the false membrane. The solution is prepared for use by mixing equal parts of pure glycerin and a saturated solution of hyposulphite of sodium in water, and is applied with a brush to the exudation and inflamed fauces once or twice daily, or as often as may be deemed necessary. H. A. Wickers (Lancet, June 6, '96).

The internal use of tincture of myrrh in diphtheria recommended. E. Graetzer (Münch. med Woch., No. 47, S. 1164, '96).

Tincture of myrrh in diphtheria very strongly recommended. The mixture is composed of tincture of myrrh, 4 parts; glycerin, 8 parts; and distilled water, to 200 parts. This is given very frequently,—every hour or even every half-hour in the day-time and every two hours at night,—infants up to the age of 2 years taking a large teaspoonful (75 minims), older children double that quantity and adults three times as much. This is continued until the membrane has nearly disappeared, when the doses are only given every two hours. After all the membrane has gone the treatment is continued for a couple of days, the interval between the doses being increased to three hours. In the case of older children and adults a gargle containing $^1/_2$-per-cent. resorcin may be employed every hour or oftener in the day-time and where it is desired the tonsils may be painted every hour with the tincture of myrrh undiluted. Where the larynx is involved the myrrh-and-glycerin mixture in an inhaler or spray to be used every half-hour. By this method only one case out of eighty has been lost, and reports collected from several other practitioners show 182 cases with 22 deaths. Ströll (Lancet, Jan. 1, '98).

Stimulants.—These are required in every case of diphtheria showing any marked degree of constitutional depression, most of all in septic cases. The pulse and the general condition of the patient are the guides in their administration.

The best of all is, undoubtedly, alcohol. A child of three or four years can take at least 1 ounce of whisky or brandy in twenty-four hours. It should be given diluted with from 4 to 6 parts of water. In the severe cases the quantity of alcohol may be increased to several times the amount named above. It is best to give it apart from the food, as the patient may decline to take the stimulant, and may be led to refuse the food because of its admixture. Next to alcohol, strychnine is of most value. The $^3/_{100}$ part of a grain may be given every two or three hours to an infant one year old; twice that amount to a three-year-old. The drug may be pushed till the deep reflexes show an exaggeration. Digitalis and like cardiac stimulants may be called for by the condition of the heart, but most reliance is to be put in alcohol and strychnine.

Antitoxin.—The antitoxin treatment of diphtheria has been in general use the world over for the past three years, and in that time has won for itself the right to be regarded as a specific.

> [The history of the introduction of the diphtheria antitoxin may be found in Welch's article in the "Transactions of the Association of American Physicians" for 1895, page 313, and in brief in the article on "Diphtheria" in volume i of the Annual of the Universal Medical Sciences for 1896.]

The antitoxin is derived from the blood of horses that have been subjected to repeated inoculations of increasing doses of the toxins produced by

the diphtheria bacillus. The course of treatment usually occupies several months. When immunity has been thoroughly established in a horse, the blood is drawn from a jugular vein into sterilized vessels and allowed to clot. The clear serum is then siphoned off into small sterilized bottles, each of which contains sufficient antitoxin for one dose and is preserved by the addition of camphor or carbolic acid in small quantity. The antitoxin thus prepared is a clear, limpid fluid, having the color of blood-serum. If kept in a cool, dark place, it remains clear and is efficient for several months. After a year it begins to lose some of its power. Often before this time the serum becomes turbid and is unfit for use. The strength of the serum is expressed in terms of an arbitrary unit, dependent upon its power to neutralize definite quantities of diphtheria toxins. Upon each bottle of antitoxin is indicated the number of antitoxin units which it contains.

Little is yet known of the nature or method of action of the antitoxin. According to one theory, its action is purely chemical, neutralizing the diphtheria toxins present in the blood; according to another, it acts by increasing the resisting power of the cells of the body to the diphtheria toxins.

We have, as yet, no means of determining accurately the dose of antitoxin suitable to each case of diphtheria. It depends upon the severity of the case, the time of injection, and to a slight extent upon the age of the patient. We judge of the severity of the case by the location and extent of the membrane and the degree of constitutional depression. The tendency is constantly toward the use of larger doses of the antitoxin. In the early days of its use the antitoxin was comparatively weak and large quantities, as much as 20 cubic centimetres, were required for a single dose. Many of the unfavorable results at first reported were doubtless due to the large quantities of horse-serum which it was necessary to inject. It was also a difficult and painful procedure to introduce such quantities of fluid hypodermically. The antitoxin now used is many times stronger; so that even the largest doses rarely require more than 5 cubic centimetres. This concentration of the serum leaves us much more free in increasing the power of the first injection.

For children under two years of age, severe cases, including all laryngeal cases, are usually given 1000 units, mild cases 600 to 700 units for the first dose. For children over two years, in severe cases, including all laryngeal, 1500 to 2000 units are employed, in mild cases 1000 units for the first dose. Some physicians employ stronger doses than these; as much as 3000 units may be given at a single injection. If no marked improvement follows the first injection, the dose may be repeated in from twelve to twenty-four hours. Third injections may be given, but are rarely necessary and are of little benefit, as the antitoxin has but little influence by that time.

> In communities in which diphtheria is prevalent, 60 units sufficient to afford protection. Among 10,000 thus treated only 10 acquired diphtheria. To those who developed diphtheria after the 60 units and had a mild attack, nevertheless 150 units should be given. When infection is virulent, 600 units: a full curative dose. Several doses at intervals more serviceable than a single large dose. Behring (Deutsche med. Woch., Nov. 15, '94).
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> Quantity required in a case varies from 1000 to 4000 units of Behring's standard, according to the weight of patient and severity of the disease. W. H. Park (Med. Fortnightly, Dec. 2, '95).

From 1 1/4 to 2 1/2 drachms are enough for benign cases taken at the onset; 4 to 6 drachms in severe cases or when they have passed several days; up to 1 ounce or even beyond in very severe cases. When breathing is embarrassed tracheotomy may be rendered unnecessary by an injection of 4 to 6 drachms, followed by another of from 2 1/2 to 4 drachms if improvement is not satisfactory. Better to inject at onset a dose of serum stronger than necessary, cutting short the malady rather than to inject weak doses at intervals. In infants under 1 year old as many as 15 minims may be injected as the child numbers months. In adults not necessary, unless case extremely grave, to inject more than 4 to 6 drachms the first time. Roux (Med. Press and Circular, Mar. 20, '95).

Literature of '96 and '97.

That 600 units the most beneficial dose proved by the collective investigation of the Deutsche medicinische Wochenschrift, bearing upon 10,312 cases. Average percentage of 6 per cent. of deaths when 600 units used, average percentage of 14.6 when 1000 units used. (Annual, '96.)

The committee of the American Pediatric Society recommends that antitoxin should be given at the earliest possible moment in all cases of suspected diphtheria.

All cases of laryngeal diphtheria, the patient being two years of age or over, should receive as follows: First dose, 2000 units at the earliest possible moment; second dose, 2000 units twelve to eighteen hours after the first dose, if there is no improvement in symptoms; third dose, 2000 units twenty-four hours after the second dose, if there is still no improvement in symptoms.

Patients under two years of age should receive 1000 to 1500 units, the dose to be repeated as above. Editorial (Therap. Gaz., Oct. 15, '97).

The injections of antitoxin may be made upon almost any part of the body, now that the quantity of serum used is comparatively small; the abdomen, thighs, or back may be preferred. An hypodermic syringe capable of holding 5 cubic centimetres is most convenient, but the ordinary hypodermic may be used in emergency. Some slight pain, redness, and œdema may be seen at the site of the injection, but nothing more, if proper care be taken in making the injection.

Careful sterilization of the skin at seat of injection and hands of physician. Complete sterilization of syringe by boiling fifteen minutes in a soda solution; needle dipped into alcohol and a 2-per-cent. solution of carbolic acid. Fischer (Med. Rec., Apr. 6, '95).

Literature of '96-'97-'98.

Reduction of post-injection accidents by heating the serum. In 1895-'96, out of 1365 patients treated with unheated serum, 208, or 15.2 per cent., suffered from post-injection accidents. In 1897, however, of 251 patients injected with the warmed serum, accidents were manifested in only 12, or in 4.7 per cent. The method of preparing the serum is as follows: It is collected under conditions of as perfect asepsis as possible, and without the addition of any antiseptic, and is put into small flasks of the capacity of ten cubic centimetres, closed with a cork and a capsule of caoutchouc. These flasks are kept for twenty minutes at a temperature of between 138° F. and 139° F. The heated serum is in no way inferior to that not so treated. Spronck (Gaz. Hebd. de Méd. et de Chir., Apr. 21, '98).

General eruptions may be seen in a large percentage of the cases in which antitoxin is used, if watch be kept for them. The eruption is in the form of an urticaria, as a rule, and develops about the tenth day after the injection. It may be transient and give no trouble or may continue for several days and be very annoying.

Literature of '96 and '97.

Two hundred and forty-nine cases of eruptions following the use of antitoxin in 1972 cases of diphtheria. The rashes seem to depend directly upon the amount of antitoxin injected. If the rash is due to antitoxin, there is little or no suffusion of the eyes, no cough, no eruption on the palate, and the initial lesions of this eruption may appear on any part of the body; while in measles the rash appears behind the ears and on the neck and chest and extends downward. If due to antitoxin, it will have disappeared in from twenty-four to forty-eight hours, at which time a measles eruption would be at its height. The rashes due to antitoxin assume various forms. Cases have been observed in which it resembled an eruption of tinea; others where it had the appearance of rose spots; and in two instances the eruptions have been remarkable on account of their character. In one of these it was a true eczema, involving the greater part of the trunk, and also the head. The other eruption commenced as a diffuse erythema of various parts of the body, and was quite general in character.

A typical erythema multiforme has been observed in a few cases, and an erythema or an urticaria have been also observed, localized at the point of the injection of the antitoxin. The earliest cases appear on the second day after the injection, but it is rather unusual to expect any rash until the fourth day, and most of them appear at about the end of the first week or ten days. F. L. Morse (Annals of Gyn. and Ped., vol. x, No. 7, '97).

Temporary albuminuria has been repeatedly noted after immunizing doses of antitoxin, but this disturbance of the kidneys has always passed off without symptoms or sequelæ.

Swelling of the joints has also been reported in some cases, but must be very rare. These sequelæ of the use of antitoxin seem to be dependent upon the quantity of serum employed in the injection, and have certainly been much less frequent since the concentration of the antitoxin has allowed the use of smaller quantities of the serum.

The effects of the antitoxin upon the diphtheritic process may be almost immediate, and should be evident within twenty-four hours in all cases. Although it has no bactericidal power whatever, it affects both the local and the general condition. In the throat an advancing process stops or at once begins its retrogression. The amount of discharge lessens, the swelling diminishes, the membrane ceases to spread, begins to soften, and becomes looser. The favorable influence is quite as marked in the larynx as upon other parts. The stenosis is relieved, as a rule, and the membrane is more rapidly thrown off. The general testimony is that, of the laryngeal cases, a much smaller proportion requires operative treatment for the relief of the stenosis since antitoxin has been used.

If intubation is resorted to, the tube is more often coughed out, or can be removed earlier than under any other form of treatment.

Literature of '96 and '97.

In 1892 the mortality of 5546 cases of intubation was 69.5 per cent.; 30.5 per cent. recoveries. In the cases treated with antitoxin and operated upon, the mortality was 27.24 per cent. The mortality of laryngeal diphtheria at present rests at 21.12 per cent.; 60 per cent. approximately have not required intubation; and the mortality of operated cases is at present 27.24 per cent. McNaughton and Maddren (Med. News, May 15, '97).

The constitutional effect of the injection is as marked as the local. Usually the temperature falls within twenty-four hours, the pulse improves, the mind is

clearer, and the patient is evidently better in every way.

With sufficient number of doses temperature brought down to normal, yet at times remittent fever, lasting many days, appears; constant fall of temperature and pulse-rate. Monti (Wiener klin. Woch., No. 4, '95).

High temperature with corresponding rapidity of pulse, varying according to age and form of disease, fell following day and was normal third day when no complications present. Distinct disparity between temperature and pulse frequently present. Disturbances of the circulatory system, among 154 cases, caused no deaths and did not in any noticeable way hinder recovery. Variot (La Semaine Méd., Mar. 6, '95).

Rise of temperature always an important one; return to normal then very gradual, but temperature often remains very high; repetition of injection caused renewal of the effect produced. Kurt Müller (Berliner klin. Woch., No. 37, '95).

Prompt fall of temperature accompanied by remarkably improved subjective sensations, typically altered course of fever. Heubner (Weber die Erfolge der Heilserum-behandlung bei Diphtherie, '95).

Literature of '96 and '97.

Temperature of 106.6° F. twenty hours after injection in a child and later on the disparity noted by Variot between temperature and pulse. Legendre (Annual, '96).

Rise in temperature after injection not only with antidiphtheritic serum, but also with artificial serum of Hayem and with the serum of non-immunized animals. Hutinel, Debove, and Sevestre (Annual, '96).

The cases apparently severe or fatal are transformed into mild ones. Baginsky tells us that, in recording the effects of antitoxin upon the various types of diphtheria, he found it necessary to require his assistants to write their judgment of the severity of the cases upon the admission card, when each case was first seen, since the antitoxin in most cases completely changed the picture.

The time of the injection has a most vital relation both to the immediate effect and to the ultimate outcome of the case. In experimental work an animal can usually be saved from a fatal dose of diphtheria toxin, if antitoxin is given within forty-eight hours, but not later. Clinically good results can usually be had if antitoxin is given within three days of the onset of the diphtheria, but later than that its influence is greatly lessened. In the "Antitoxin Report of the American Pediatric Society" the mortality of first-day injections was 4.7 per cent.; of second day, 7.4 per cent.; of third day, 8.8 per cent.; of fourth day, 20.7 per cent., and of fifth day, 35.3 per cent.

Literature of '96 and '97.

Report of the American Pediatric Society's collective investigation into the use of antitoxin in the treatment of diphtheria in private practice.

Result as influenced by the time of injection: 5794 cases with 713 deaths,—a mortality of 12.3 per cent., including every case returned; excluding 218 cases moribund at the time of injection, or dying within twenty-four hours of the first injection, the mortality was only 8.8 per cent.

Of the 4120 cases injected during the first three days there were 303 deaths,—a mortality of 7.3 per cent., including every case returned. If, again, the moribund cases are excluded, there were 4013 cases with a mortality of 4.8 per cent. After three days the mortality rises rapidly, and does not materially differ from ordinary diphtheria statistics.

Results as modified by age of the patients: The highest mortality is found to be under two years; but including all cases returned, even those moribund

when injected, the death-rate was but 23.3 per cent. After the second year there is a steady decline in mortality up to adult life. Of 359 cases over 15 years old, there were but 15 deaths.

Paralysis: Out of 3384 cases paralytic sequelæ appeared in 328 cases (9.7 per cent.). Of the 2934 cases which recovered, paralysis was present in 276, or 9.4 per cent. Of the 450 cases which died, paralysis was noted in 52, or 11.4 per cent.

Sepsis: This is stated to have been present in 362 out of 3384 cases, or 10.7 per cent. It was present in 145, or 33 per cent., of the fatal cases.

Nephritis: Nephritis was present 350 times, or in 10 per cent. of the cases. The statements on this point are not quite satisfactory.

Whole number of cases of laryngeal diphtheria, 1704; mortality, 21.12 per cent. (360 deaths).

The cases occurred in the practice of 422 physicians in the United States and Canada.

Operations employed:—

(*a*) Intubation in 637 cases; mortality, 26.05 per cent. (166 deaths).

(*b*) Tracheotomy in 20 cases; mortality, 45 per cent. (9 deaths).

(*c*) Intubation and tracheotomy in 11 cases; mortality, 63.63 per cent. (7 deaths).

Number of States represented, twenty-one, the District of Columbia, and Canada.

Non-operated cases, 1036,—60.79 per cent. of all cases; mortality, 17.18 per cent. (178 deaths). (Archives of Pediatrics, July, '96.)

In Japan, prior to serum-therapy, the mortality was 56 per cent.; after its use in 353 cases the mortality was 8.78 per cent. Of 110 cases in which injections made within forty-eight hours after invasion, all ended in recovery. Of 33 cases treated after eighth day of the disease 11 were lost. Kitasato ("Serum Treat. of Diph.," '96).

In 600 cases of diphtheria treated, one-half were given antitoxin, the other half had no antitoxin. The Klebs-Loeffler bacillus was found in all cases. The cases were treated in the same hospital, had exactly the same food, drugs, and stimulants.

In the 300 cases treated with antitoxin there were 129 tracheotomies; 60 died, the death-rate being 20 per cent.

In the 300 cases treated without antitoxin there were 199 tracheotomies and 158 deaths,—a death-rate of 52.7 per cent. The earlier the serum is used, the better the results; however, it is of value even when given late. In 20 per cent. of laryngeal cases, even when there is dyspnœa, it lessens the necessity for operation. Clubbe (Brit. Med. Jour., vol. xi, p. 1177, '97).

Laryngeal diphtheria, in any epidemic, is never mild, but has always had a mortality of from 90 to 95 per cent., reduced by operation, intubation, or tracheotomy, to from 72 to 76 per cent. Intubation without serum shows a mortality of 76 per cent.; in conjunction with a serum of 25 per cent., and, eliminating cases of death within twenty-four hours of injection, a mortality of 10 per cent. The reduction of mortality from 76 to 10 per cent. is to be credited to antitoxin. Antitoxin should always be administered as early as possible, and in laryngeal cases without waiting for the bacteriologist's report. No child should be allowed to die of laryngeal stenosis without an operation, preferably intubation, and serum should be injected at once, regardless of the stage of the disease, as most desperate cases often end in recovery. Halsted (N. Y. Med. Jour., vol. lxv, '97).

Statistics from the Imperial Board of Health in Berlin: The reports, gathered from April, 1895, to March, 1896, were furnished by 258 physicians from 204 institutions. Of 9581 cases of diphtheria treated with antitoxin, 1489 proved fatal, or $15\,{}^{1}/_{2}$ per cent. After deducting the absolutely hopeless cases, which perished within the first twelve hours after they were seen, the mortality is reduced to $14\,{}^{7}/_{10}$ per cent. Adding to these 9851 cases the result of a former report (January to April, 1895) and 1328 cases from March to July, 1896, published later, a

total of 13,137 cases, divided over eighteen months, furnished a mortality of 2082, or 15 $^{8}/_{10}$ per cent. Of these 4085 patients, or 42.6 per cent., presented the laryngeal variety, 2744 of which were operated upon, with a mortality of 32 $^{3}/_{10}$ per cent. The mortality of cases treated on the first day was 6.6 per cent.; that of those treated on the second day, 8.3 per cent.; of those treated on the third day, 12.9 per cent., of those treated on the fourth day, 17 per cent.; and of those treated on the fifth day, 23.2 per cent. Dieudonné (Inter. Med. Mag., Dec., '97).

Coupling the danger of delay with the harmless nature of the antitoxin, it is quite plain that antitoxin should be given in every case where the diagnosis of diphtheria is probable. Only in mild cases may we wait for the bacteriological diagnosis. Especially in all laryngeal cases should the immediate use of antitoxin be advised.

No harm is done if the case is not diphtheria, and, if it is, a great advantage is gained.

We may safely assume that the use of antitoxin is harmless, for if all the reported cases of sudden death or aggravation of cardiac or renal disease or other unfavorable influence were accepted as proved, they could not, for a moment, be weighed against the accumulated evidence of the curative effect of antitoxin in diphtheria.

Literature of '96 and '97.

The following are conclusions drawn from laboratory experiments: 1. Antitoxic serum does not seem to be capable of causing threatening symptoms and speedy death even when brought quickly into the blood-current in very large doses. 2. The carbolic acid used as preservative must be in such a weak solution as to be unable to cause the characteristic carbolic convulsions. 3. Even very small quantities of air will cause severe disturbances and ultimate cessation of breathing, and to this cause the sudden deaths are to be attributed. A. Seibert and F. Schwyzer (N. Y. Med. Rec., No. 913, p. 708, '96).

Effect on the kidneys of small preventive doses (2 to 3 centimetres) of diphtheria antitoxin studied in 73 cases, and shows no deleterious influence. No traces of albumin were discovered in the urine. Also report of a case of severe scarlet fever and nephritis in which diphtheria supervened, and larger doses of the antitoxin (10 centimetres) were administered. The diphtheria was arrested at once, and the nephritis also seemed to be favorably affected and retrogressed, although more slowly. Rojanski (Botkine's Gazette, No. 36, '96).

That evidence has been so fully presented in the articles by Welch, Biggs and Guerard, and the Report of the American Pediatric Society, already referred to, and is so complete, that no attempt is made to introduce it here.

There are certain definite limitations of the efficiency of the diphtheria antitoxin. It has already been pointed out that not all the lesions of diphtheria are produced by the action of the diphtheria bacillus or its toxins.

Certain of them, especially the broncho-pneumonia and nephritis, are believed to be due to the action of streptococci.

Diphtheria associated with streptococci is the gravest form met with; in children it is the most frequent determining factor of broncho-pneumonia. E. Roux (Universal Med. Journal, p. 289, '94).

In the severe and most highly infectious forms of diphtheria accompanied by marked hyperæmia and swelling of the faucial and adjacent surfaces, streptococci occur not only in the superficial, inflamed parts, but in the deeper, contiguous tissues, as the submaxillary and perilaryngeal glands and the adjacent connective tissue. In some cases these adventitious germs, by penetrating deeply, cause not only a cellulitis which

may end in suppuration, but set up a broncho-pneumonia. H. Barbier (Gaz. Méd. de Paris, Sept. 30, '94).

Organisms present in 32 fatal cases: Loeffler's bacillus only, 37.5 per cent.; with streptococci, 25.0; with staphylococci, 18.7; with streptococci and staphylococci, 18.7. In all cases staphylococci pyogenes aurei found. No fatal results took place when only cocci were present. Shuttleworth (Lancet, Sept. 14, '95).

Literature of '96-'97-'98.

By mixing cultures of the streptococcus with those of the Klebs-Loeffler bacillus, a considerable increase in the virulence of the latter is observed. The dose necessary to kill a guinea-pig was much less than that required for a culture of the diphtheria germ. If the dose was decreased to the point of permitting life for two or three weeks, there was observed, besides emaciation, a diminution of the secretion of urine, which became sanguinolent. The autopsy showed especially-profound alterations in the kidneys, visible to the naked eye. The glomerules were swelled, and projected above the cut surface. The microscope showed the shedding of epithelium from the urinary tubules and the presence in their lumen of numerous altered red globules. These lesions cannot be obtained with pure cultures of the streptococcus, but only by adding to the diphtheria cultures the toxins of streptococci obtained from cultures four weeks old. Bonhoff (Hygienische Rundschau, No. 3, S. 97, '96).

In cases of mixed infection the symptoms of ptomaine poisoning due to the Klebs-Loeffler bacillus may be preceded by those due to staphylococci and streptococci, which latter may even subsist before the onset of the graver symptoms. If the Klebs-Loeffler bacillus is the "principal invading germ," then "antitoxin will bring the crisis of the disease within twenty-four hours. If it is the streptococcus, there will be a long, hard fight." Streptococcic angina is marked by pain, and is not benefited by antitoxin. Jaques (Lancet, Jan. 15, '98).

Upon these processes the antitoxin can have no direct effect. By lessening the depression produced by the diphtheria, antitoxin may enable the patient to resist the further attack of the streptococci or other pathogenic organisms; it cannot be expected to do more. It has also been urged against the antitoxin that diphtheritic paralysis is quite as frequent after its use as it was without antitoxin.

To this two reasonable replies have been made: One, that the nervous system is most susceptible to the action of the diphtheria toxins and therefore most difficult to protect; so that, while antitoxin can save the life of the patient, it cannot protect him from the particular effect of his disease. The other is the ingenious suggestion that by saving the lives of many who, suffering from severe diphtheritic infection, would, in all probability, have died under any previous form of treatment, antitoxin increases the number of those in whom we should reasonably expect to see diphtheritic paralysis develop.

The method of administration of the antitoxin and its mode of action are such that it in no way interferes with the use of any other form of treatment that may be regarded beneficial. Being given hypodermically, it does not disturb the stomach or interfere with feeding or medication. Fish, of St. Louis, has recently reported experiments going to prove that antitoxin given by mouth is effective. Similar experiments made by Park gave negative results. It is doubtful whether any advantage would be gained if it were possible to introduce the antitoxin in this way.

Literature of '96-'97-'98.

Antidiphtheria serum given by the mouth has proved eminently satisfactory in nine cases. The effect was quite as

good as if the serum had been given hypodermically, and no evil results followed,—no gastric disturbance, no skin eruption, and no joint or renal affection. Before deciding as to the dose required, however, further experience is desirable. In the first five cases the dose given was the same as would have been given hypodermically. De Minicis (Gaz. degli Osped., July 19, '96).

The known immunity of infants at the breast is brought about by the maternal milk's possessing antitoxic properties. Prophylaxis by means of the administration of antitoxin by the alimentary canal must fail, for the antitoxic property is not communicated to the serum of the patient. The same applies to the oral administration of antitoxin for curative purposes, for antitoxin is so changed or destroyed in the liver as to be prevented from entering the blood and there acting. Escherich (Wiener klin. Woch., No. 36, '97).

For curative purposes the administration by the mouth should be restricted to exceptional cases; but for prophylactic purposes this method should receive the preference. J. Zahorsky (N. Y. Med. Jour., Mar. 19, '98).

Laryngeal stenosis may call for further treatment. The general testimony is that antitoxin exerts a marked, in some cases a marvelous, influence upon diphtheritic stenosis. It is also agreed that since the general use of antitoxin a greater percentage of laryngeal cases have escaped operative interference than were before, and of those finally operated upon a greater number had recovered. The triumph of antitoxin has been that of intubation as well. (See INTUBATION.)

Tracheotomy has practically passed out of use in diphtheritic stenosis of the larynx.

Tracheotomy should be performed in place of intubation in (1) cases which, owing to spasm or œdema of the glottis, the tube cannot be introduced by the O'Dwyer method; (2) cases in which the tube enters the larynx, but pushes the membrane ahead of it; (3) cases of ascending croup, in which the lower and larger opening of tracheotomy allows the membrane and the secretions a better avenue of escape. Brothers (N. Y. Med. Jour., Jan. 18, '93).

Many forms of treatment were formerly combined with the use of antitoxin, but, as the power of the antitoxin has been more fully demonstrated, the tendency to rely upon it has become stronger. At the present time, apart from the general treatment—diet, rest, etc.—after giving antitoxin we confine our efforts to the careful cleansing of the nose and throat and the use of stimulants.

Before the serum-treatment the intubation-mortality 66 per cent. in 124 cases; since antitoxin used, mortality reduced to 27.5 per cent. in 73 cases; all cases, of course, severe ones. Mugues (Thèse de Lyon, '95).

Intubation. 1. Time for withdrawing the tube varies within very wide limits. 2. Average time, seventy-nine hours before and sixty-one hours after introduction of serum-treatment. Bókaï (Deutsche med. Woch., Nov. 14, '95).

Literature of '96-'97-'98.

Advantages of intubation in diphtheria. It is rapid and requires no anæsthetic; there is no operation; the respiration takes place through the natural openings. In these days of antitoxin, if there is skilled assistance to rely on during the absence of the operator, it has enormous advantages over tracheotomy, but these quickly disappear when skilled assistance is absent, and it must not be forgotten that tracheotomy-tubes can now be removed after a much shorter period than formerly. Hughes (Scottish Med. and Surg. Jour., June, '97).

There is still some doubt as to the method of taking out the tube after intubation. There are disadvantages at-

tending the thread method, and especially because the fixing of the tubes thus produced does not allow of its free play, and hence causes erosion of the parts. The extractor, on the other hand, is hardly possible in private practice, as a sudden stoppage of the tube by membrane may cause suffocation unless the tube can be withdrawn without delay; it also requires considerable skill, especially where a small tube sinks deeply into the larynx. Where attempts at extraction cause a small tube to sink farther down, pressure with the thumb on the trachea, just below the cricoid cartilage, where the end of the tube can be felt; the cough thus produced forces the tube out. This method of expression never fails. The pressure may be made with both thumbs, the fingers finding support on the neck; it should be directed inward and directly upward. If more powerful pressure is exerted, the tube may be forced, not only into the mouth, but even completely out of it. No disadvantages attend this method. Trumpp (Münch. med. Woch., Jan., '98).

The operation of intubation and extubation is not, in itself, difficult; but every one contemplating becoming a safe operator should practice the operation on the cadaver. A rapid tracheotomy may become necessary if, in the act of tubing, the stenosis should suddenly become complete. Intubation in the adult is a difficult and rather unsatisfactory procedure. Augustus Caillé (Post-graduate, Oct., '97).

The results of intubation after the administration of antitoxin have been most brilliant. Whereas two-thirds of such cases died before the use of antitoxin, with it about two-thirds recover. The indications and technique of the operation are described in the article on INTUBATION.

Tracheotomy should be resorted to only when no trained intubator can be had or intubation has been tried and has failed. The Continental practice of resorting to a secondary tracheotomy if a tube has been worn four days rests upon no rational basis and should be abandoned. By using hard-rubber tubes, the perfection of which was one of O'Dwyer's last labors, we may leave the tubes in the larynx for months without danger of harm.

W. P. NORTHRUP,
DAVID BOVAIRD,
New York.